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An International Magazine
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Volume LII

January to June, 1931

PUBLISHED BY
THE SURGICAL PUBLISHING COMPANY OF CHICAGO
54 EAST ERIE STREET, CHICAGO

1931

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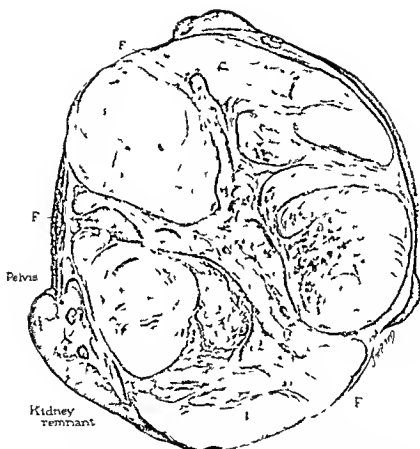


Fig 2 Case 1 The surfaces made by cutting, Showing, remnant of kidney with some dilatation of the pelvis and exceedingly large quantity of fat, F

Mixed Tumors of the Kidney in Infancy and Childhood—Herman
L. Kretschmer and William G. Hibbs

SURGERY, GYNECOLOGY AND OBSTETRICS

AN INTERNATIONAL MAGAZINE, PUBLISHED MONTHLY

VOLUME LII

JANUARY, 1931

NUMBER 1

MIXED TUMORS OF THE KIDNEY IN INFANCY AND CHILDHOOD

A STUDY OF SEVENTEEN CASES¹

HERMAN L. KRETSCHMER, M.D. F.A.C.S., AND WILLIAM G. HIBBS, M.D., CHICAGO

From the Presbyterian Hospital of Chicago and the Children's Memorial Hospital of Chicago

THIS paper is based upon a study of 17 cases of malignant tumors of the kidney which occurred in infants and children. Some of the patients were under our personal observation and some of them were on the services of others at the Children's Memorial Hospital and the Presbyterian Hospital of Chicago, and we were given the opportunity of studying the pathological specimens removed from such cases.

An interesting fact brought out in our study was that, in many instances, the true nature of the tumor was not recognized either at the time of operation or at the time the histological examination was made. For example, a review of the case histories showed the following histopathological diagnoses: multiple cell type sarcoma, myxomatous tumor, alveolar round cell sarcoma, myxomatous sarcoma, and, in one instance, hypernephroma. A careful histological study of these tumors, however, showed that the diagnoses made were not correct and that the tumors really belonged to the interesting group known as mixed tumors.

Malignant tumors of the kidney occurring in infants and children are rare, as may be seen from a review of the literature. Bugbee and Wollstein, in a review of 4,903 autopsies performed on infants and children, report no cases of malignant renal tumor. Lowsley and

Butterfield, in a recent series in which they reported their findings in 100 cases of urological lesions in infants and children, mention no case of malignant tumor. Thomas and Birdsell, in an exhaustive report of their experiences in children, do not include any cases of malignant renal tumor, but Magoun and McCarty report finding malignant renal tumors in 7 children.

According to Thomas, in infants and children tumors of the pelvis of the kidney are rare as compared with the occurrence of tumors of the renal parenchyma. He reports a very interesting type of tumor of the kidney pelvis. Deming some time ago reported a case of congenital sarcoma in a child 29 days old. Hyman, in a series of 70 renal neoplasms, reported 10 cases of mixed tumors. Hasner recently reported 4 cases of mixed tumors of the kidney, 3 in infants and children and 1 in a man aged 45 years. Recently Wollstein reported a series of 18 cases of malignant tumors of the kidney in children, 17 of them were mixed tumors.

That, during infancy and childhood, malignant tumors occur in other organs is evident from a somewhat cursory review of the literature. Among recent articles dealing with this subject are the following: "Angiosarcoma of the Liver" (Bondy), "Primary Carcinoma of the Liver" (Castle), "Tumors of the Ovary"

¹Read at the annual meeting of the American Association of Genito-Urinary Surgeons, French Lick, Indiana, May 22, 23, and 24, 1930.

(Downs), "Sarcoma of the Small Intestine" (Tullerton), "Carcinomatous Ovarian Teratoma" (Harris), "Sarcoma of the Bladder" (Mixer). Therefore, while the kidney is not the only organ that may be the seat of malignant disease in infancy and childhood, it is true that this organ is easily the most frequent site of malignant disease in the genito urinary tract, and that the most common type of malignancy is the so called mixed tumor of Wilms.

REPORT OF CASES

A report of the 17 cases which form the basis of this study follows.

CASE 1 B N female white aged 1 year was admitted to the Children's Memorial Hospital on the service of Dr. Joseph Brennemann August 28 1928 with the complaint that a mass was present on the left side of the abdomen. About 4 months previously that is when the child was 8 months old, the mother had noticed some distention of the left side of the abdomen. The mother stated that she did not think the child had lost weight but there was no gain in weight and her color was poor. There were no other symptoms.

Physical examination disclosed a fairly well nourished child, rather pale, with a prominent abdomen and with heart and lungs negative. A very prominent visible mass filled the entire left side of the abdomen. The mass extended from the arch of the ribs to the crest of the ilium and beyond the midline at the level of the umbilicus. It was smooth and firm and not tender. Temperature on admission to hospital was 100 degrees. Blood count red blood cells 3 000 000, white blood cells 19 200 polymorphonuclear neutrophils 67 per cent lymphocytes 30 per cent, transitionals 3 per cent. Urinalysis showed the urine clear reaction, acid albumin, 0 sediment no blood cells and 30 pus cells per cubic millimeter. Cystoscopic examination showed the bladder to be normal. Ureteral catheters were passed without obstruction. The urine from the right kidney was normal no urine was obtained from the left kidney. Roentgen ray examination of the chest was negative. Pyelograms of the kidneys showed the right normal, the left that no fluid entered the left pelvis.

Pre operative diagnosis malignant tumor of the left kidney.

Operation (H L K.) September 28 1928 (ether anesthesia). The usual oblique kidney incision was made. A large solid tumor of the kidney about the size of the patient's head, was found. The veins covering the tumor were unusually large and tortuous. The surface was smooth consistency firm color gray. The tumor extended up under the costal arch above and into the iliac fossa below and beyond the midline. Because of the size and fixation of the

growth it was decided not to do a nephrectomy. Two pieces of tissue were removed for histological study.

Convalescence was uneventful. It was advised that the patient be given deep X ray treatment.

The patient was admitted to the Presbyterian Hospital for deep roentgen ray treatment and received, at the hands of Dr. C. B. Rose 27 treatments. During the course of these treatments there was definite diminution in the size of the tumor, so that at the end of the course nephrectomy was advised.

December 5 1928 therefore the patient again entered the Children's Memorial Hospital.

General examination by Dr. Joseph Brennemann on January 7, 1929 gave no additional information, and no evidence of metastases. Dr. Brennemann concurred in the plan to carry out a nephrectomy. Blood count at this time showed red blood cells 2 864 000, white blood cells 13 400, haemoglobin 50 per cent. Urinalysis showed reaction acid, albumin trace, sugar 0.20 white blood cells per low power field blood 0.

Roentgen ray examination of the chest was negative for evidences of metastasis. The temperature varied from 100 degrees to 101 degrees.

Operation (H L K.) January 10, 1929 (ether anesthesia), left nephrectomy. The tumor mass was freed with a great deal of difficulty because of the presence of adhesions. During the course of the dissection a rent in the diaphragm and a tear in the peritoneum occurred. The tear in the diaphragm was sewed with catgut and the opening in the peritoneum was closed with a running suture of catgut.

Convalescence was uneventful.

Histological diagnosis adenomyosarcoma of the left kidney.

A recent examination revealed the presence of large tumor masses in the abdomen and roentgen ray examination of the chest showed the presence of pulmonary metastases. The child died May 18 1929 4 months after the nephrectomy. No autopsy was obtained.

Description of specimen removed at operation. The kidney and tumor mass together weighed 1 738 grams and measured 17 by 13½ by 14½ centimeters in maximum dimensions. The mass in general was oval. Its surface was smooth except for lobulation depressions of the tumor mass and for 12 nodulations of the surface 3 of which were 2 centimeters in diameter, and the others 3 to 3.5 centimeters in diameter. The nodulations bulged outward from the central tumor mass and each was covered with a common capsule. The entire mass was firm. It flattened only slightly when placed on a hard table and was in general a gray to light brown. Delicate blood vessels only were present, and these were distended. In places the mass was dark red to brown apparently because of old blood and new dark tissue.

Firmly attached to the upper pole was the remnant of this kidney. Grossly the kidney tissue was

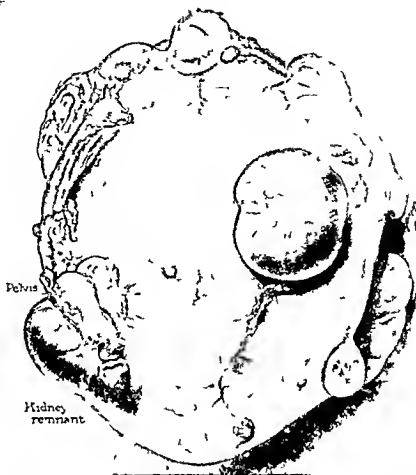


Fig 1 Case 1 Kidney and tumor removed surgically Small remnant of kidney tissue Slight dilatation of the kidney pelvis Nodular surface of the tumor which in general outline is circular

sharply defined, normally lobulated, dark brown, and its surface was flattened out so as to be continuous with the general contour of the mass. The total kidney substance present measured about 3.5 centimeters in diameter and weighed approximately 30 grams. Upon four transverse serial sections of the entire mass, the surfaces made by cutting were uniformly firm throughout all portions and consisted of clumps of tissue 3 to 4 centimeters in diameter, of a mottled gray to light brown, surrounded by narrow bands of densely rigid fibrous-like tissue. A center nodule was light yellow brown, easily friable, and was evidently the result of pressure necrosis. Near the periphery of the mass at the lower pole there was a sharply defined dark brown spongy porous nodule 3 centimeters in diameter. Nowhere was there any substance that was not cut easily by a sharp knife.

In histological sections of the tumor, the tissue consisted of densely packed cells which stained deeply. Although most of the cells were in clumps, many of them were arranged in bundles, that is, the nuclei were parallel, and about half of the cells had deep chromatin staining properties and the other cells were either diffusely granular, two to three times as long as they were wide, and many of them

were vesicular. Between clumps of cells isolated eosinophilic polymorphonuclei were present. The nuclei that were vesicular were generally more spherical than oval. The cytoplasm generally was in strands and these stained pink and had transverse striations. Throughout the sections there were sharply defined tubular gland structures. These tubules in general were most abundant where the epithelial cells were densest. Nuclei of the tubular gland cells stained deeply, they were more oval than round and were situated in the mid portion of the cell, which is semicolumnar in shape. In the lumen of the tubules the content was of non cellular globoid structure and cell detritus. Where the tissue was less cellular, the nuclei were more spherical and here isolated lymphocytic polymorphonuclei were present. In the central portion the nuclei stain was faint, the cells were scanty, and the cytoplasm was grossly granular and stained poorly, as in pressure necrosis. Leucocytes were moderately abundant throughout, but in places they were present in clumps.

In sections stained with phosphotungstic acid hematoxylin, there were found dense striated muscle fibers in bundles. These fibers and bundles ramified throughout the epithelial cells masses, but were more

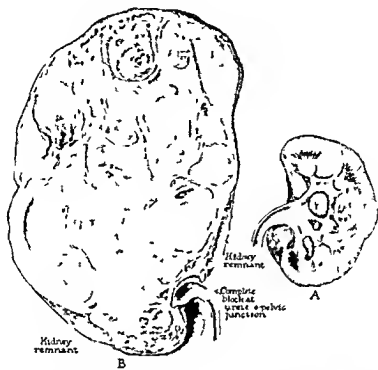


Fig 3 Case 2 A Normal kidney B Tumor removed at operation Only a small remnant of kidney tissue remains at the lower pole There is complete block at the ureteropelvic junction

abundant, surrounding the clumps of epithelial cells, than in them. In places the transverse striations of the muscle fibers were so compact that the fiber resembled a coil spring. Elsewhere the striated muscle fibers had a heterogeneous arrangement.

The sections of the nodular surfaces made by cutting consisted of compact epithelial cells with deep chromatin stain and were surrounded by a loose network of cells with finely granular, almost spherical, nuclei which stained faintly. Red blood cells were present out in the tissue and in the delicate capillaries.

Sections of the tumor removed 4 months after surgical exploration of the tumor with biopsy, were essentially similar.

CASE 2. H. D. male white aged 2 years referred by Dr Reichert was admitted to the Children's Memorial Hospital on the service of Dr Joseph Brennemann September 5, 1928. The mother had noticed the presence of a large mass in the abdomen 1 month prior to admission. The mass had definitely increased in size. It was the mother's opinion that the mass fluctuated as to size, at times being larger and at other times smaller, but her general impression was that the mass had become definitely larger. There were no subjective symptoms except that the child appeared to be weak and poorly nourished.

Physical examination disclosed a poorly nourished, anæmic, flabby child, active, and mentally alert.

Head, neck, and lungs were negative. A systolic murmur was heard at the base. A large mass in the left upper abdominal quadrant was more easily palpable in the flanks than anteriorly. The mass was smooth, firm, and irregular in outline. Temperature on admission was 102 degrees. During the child's stay in the hospital it varied from 102 to 103.5 degrees. Blood examination showed red blood cells, 2,000,000, white blood cells, 9,000, hæmoglobin, 40 per cent, polymorphonuclear neutrophils, 51 per cent, lymphocytes 44 per cent, eosinophiles, 3 per cent, transitionals 2 per cent. Blood chemistry examination revealed urea, 60, urea nitrogen 28, uric acid, 5.5, creatinin 1.6, non protein nitrogen 44, cholesterol, 250. Urinalysis showed albumin faint trace, pus, 0, blood, 0, casts, 0. Wassermann test was negative. Father's and mother's Wassermann tests were negative. Roentgen ray examination of the chest was negative.

Cystoscopic examination showed the bladder to be normal. The right ureter was catheterized. Examination of the urine obtained from the right kidney was negative. The left ureter was not catheterized. A right pyelogram showed normal kidney.

Pre-operative diagnosis tumor of left kidney, probably malignant. Operation advised but refused.

On October 16, 1928, patient again entered the hospital. One week before this admission there had been bright red blood (?) in the urine.

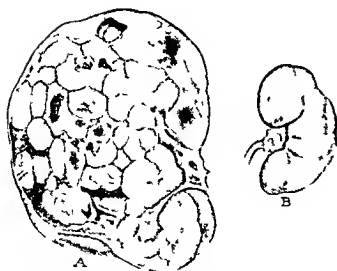


Fig 4 Case 6 A, Note the irregular lobulations and areas of necrosis, B, and the size of tumor compared with the normal opposite kidney

Operation (H L K.) October 16, 1928 (ether anesthesia) The usual oblique kidney incision was made. An exceedingly large tumor of the left kidney was found, the whole mass being firmly bound down by adhesions. Because of its enormous size and difficulty in isolating this mass it was decided not to do a nephrectomy. A small piece was removed for histological study.

Description of surgical specimen There were found diffuse epithelial cell nests, loose stroma, solitary new tubules, both inside and outside of cell nests, focal compression necrosis with suppuration, coarse striated muscle fibers in bundles.

Histological diagnosis embryonal adenomyosarcoma of the kidney

The postoperative course was uneventful. It was advised that the patient be given deep X ray therapy. The child was removed to the Presbyterian Hospital where 15 such treatments were given by Dr. C. B. Rose. After the second deep X ray treatment there was a remarkable reduction in the size of the tumor, it apparently decreasing to one half its original size. After this diminution in size, further treatment had no effect on the tumor. Examination of the patient about one month after the institution of the X-ray treatment revealed in the abdomen multiple masses, which increased rapidly in size. Coincident with this sudden swelling of the abdominal masses a large amount of sugar was found in the patient's urine.

On December 23, 1928, the patient entered the hospital for the third time. Physical examination at this time revealed the following. The patient had an old and emaciated appearance. The arms, thighs, and legs were extremely thin, the ribs were prominent. The superficial veins of the upper abdomen and chest were very prominent. On the right side, the veins were distended to the umbilicus. In the midline was felt a swelling apart from the rest of the

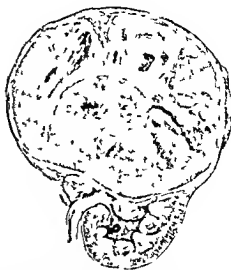


Fig 5 Case 8 Shows areas of necrosis in the center of the tumor, which is surrounded by a capsule. The tumor has displaced over one half of the kidney. Note the sharp line of demarcation between the kidney and the tumor.

general abdominal distention. The left half of the abdomen was tense and a large nodular mass was felt on the right side of the abdomen. It was hard and extended down to the umbilicus. The impression conveyed was that it was due to a much enlarged liver, the result of metastases. A metastatic nodule was noted in the right testicle. Urinalysis revealed a cloudy urine, reaction, acid, albumin + + +, sediment, loaded with bacteria, pus, o, blood, o, casts, o. Blood examination showed red blood cells, 2,320,000, white blood cells, 11,600, hemoglobin, 45 per cent.

The patient died December 26, 1928, and autopsy was done 4 hours after death.

Anatomic diagnosis primary embryonal adenomyosarcoma of the left kidney (Wilms tumor), dilatation of the pelvis of the left kidney, compression atrophy of the left kidney, multiple metastases to the liver and mesenteric lymph nodes, fibrous peritonitis, compression atrophy of the adrenal glands, implantation tumor with obstruction of the left ureter, compression dilatation of the left pancreatic plexus, compression atrophy of the liver, cholesterol deposits of the liver, malnutrition, ascites.

The essential autopsy findings were a markedly emaciated white boy, 2½ years old, by actual weight 12½ kilograms, and 97 centimeters tall, a symmetrical tumor present in the left kidney weighing 1,110 grams (see Fig 3), which had arisen within the kidney and by its growth had destroyed the kidney except for a portion of the upper pole, huge metastases into the liver, altogether weighing 2,600 grams, which compressed the liver by its rapid growth and so distorted the shape of the liver that the falciform ligament lay to the left of the midline of the abdomen and the gall bladder in the left upper quadrant of the abdomen.



Fig 6 Case 10 A Specimen removed at operation showing general rounded outline of the tumor with irregular surfaces Pelvis has been distended with salt solution is about normal in size B Specimen open a Shows a small remnant of kidney tissue b, Area of necrosis There has not been much encroachment upon the kidney pelvis by the tumor

Histological examination of the tumor of the left kidney showed loose stroma, epithelial cell nests, some of which contained tubules and others which were epithelial cell nests without tubules, striated muscle fibers in bundles extensive compression necrosis, left ureter implantation tumor with necrosis huge metastasis to the liver (Fig 16) which contained epithelial cell nests and tubules and compression atrophy of the left kidney

CASE 3 B R male white aged 5 years was admitted to the Children's Memorial Hospital on the service of Dr Sigurd Kraft August 19, 1927, with the following complaint The presence of a large mass in the abdomen Patient had been irritable for the past 21 months Three weeks before admission the mother had noticed the presence of a swelling in the abdomen which apparently caused no upsets He had not lost weight Urinary symptoms were absent During the past months he had had attacks of nausea and vomiting Physical examination disclosed a thin undernourished child not acutely ill and not in distress The tonsils were slightly enlarged and reddened The heart and lungs were negative A large mass was present in the upper left quadrant of the abdomen and extended 1½ inches to the right of the midline and well down into the lower left quadrant The mass was smooth, rather firm in consistency not tender and moved with respiration The edges of the mass were well defined Upon palpation it would seem that the

tumor sprang from the left kidney The external genitalia were negative Temperature was 99 degrees Blood examination showed red blood cells 3 800 000 white blood cells 9 600, hæmoglobin 70 per cent, polymorphonuclear neutrophils 75 per cent, lymphocytes 24 per cent, transitionals 1 per cent Von Pirquet test was negative Urinalysis revealed reaction, acid, albumin 0, sugar 0, sediment, few hyalin and granular casts occasional red blood cells occasional white blood cells Roentgen ray examination of the chest was negative, of the abdomen revealed a circular opaque shadow occupying the left upper quadrant and extending over to the right side beyond the midline

Pre operative diagnosis malignant tumor of the left kidney

Operation (Dr F M M) August 22, 1927 (ether anaesthesia) The usual kidney incision was made An exceedingly friable tumor was removed, and the vessels were ligated The wound was closed with drainage

Histological diagnosis sarcoma—multiple cell type—of left kidney

The postoperative course was uneventful The patient received six deep X ray treatments and was discharged from the hospital on October 4 1927 Examination before the child left the hospital revealed the presence of a large recurring tumor Patient died April 13, 1928

Description of surgical specimen The kidney and multiple surgically excised portions of tumor tissue

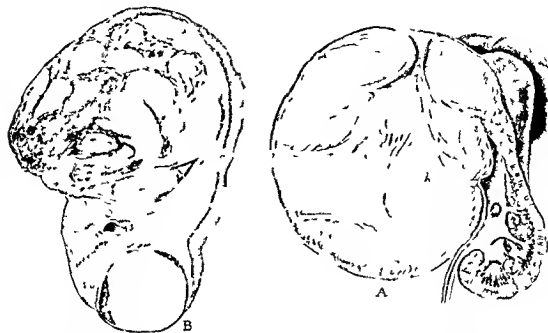


Fig 7 Case 12 A, Specimen removed at first operation Sharp line of demarcation of tumor B, Specimen of remaining kidney removed at autopsy

together weighed 450 grams The surgically excised portions varied from 2 to 30 grams in weight, they were soft, friable, occasionally smooth, compressible, and dark brown

The tumor arising from the back portion of the lower pole was sharply defined from the attached kidney

Microscopic examination showed between the tumor and the kidney itself fibrous tissue layer The kidney itself was normal except for compression where it was adjacent to the tumor and here the kidney intertubular tissue was increased and fibrous The tubules were irregular in size and shape and had large nuclei which because of the coarse granules stained deep with hematoxylin Some of the kidney tubules contained leucocytes, both polymorphonuclears and lymphocytes, but in the fibrous band between the kidney and tumor itself there was an infiltration also of polymorphonuclear leucocytes and lymphocytes Deeper into the tumor was a loose stroma network (Fig 15) containing multiple new tubules which were usually small and round, but some of them had folded walls to produce a papillary structure Epithelial cells were scattered throughout but there were no real epithelial cell nests here Elsewhere in the tumor the stroma was infiltrated with large, pale stained epithelial cells with nuclei which contained fine granules These cells were evenly scattered throughout the stroma and although they did not occur in true epithelial cell nests, they were present in compact clumps Throughout the tumor there were strands of smooth muscle but no definite striated muscle was present

CASE 4 W W, male, white, aged 5 months, was admitted to the Children's Memorial Hospital on

the service of Dr Joseph Brennemann, August 24, 1923 At this time the mother stated that 1 month before admission to the hospital she had noticed a swelling on the left side of the abdomen just below the costal margin When first discovered the tumor was about 3 or 4 inches in diameter, but it rapidly grew larger, so that now it filled the entire left side of the abdomen, causing a marked bulging The mother had noticed no loss in weight, no constipation, and no urinary symptoms Physical examination disclosed a well nourished white infant, playful and smiling The heart and lungs were negative The abdomen showed a rounded, bulging tumor mass filling the entire left half and bulging into the flanks The skin was tightly stretched over the mass and was shiny The mass was firm in consistency, a little more prominent in front to the left of the navel for about 2 inches On palpation, the mass could be outlined along the midline midway down in the left lower quadrant but the upper limits were lost under the arch of the ribs The circumference of the abdomen at this point was 18.5 inches The testicles were not in the scrotum The temperature was 99.2 degrees on admission Blood examination showed red blood cells, 3,100,000, white blood cells, 26,200, hæmoglobin, 55 per cent, polymorphonuclear neutrophils, 46 per cent, small lymphocytes, 44 per cent, large lymphocytes, 4 per cent, large mononuclears, 1 per cent, transitionals, 2 per cent, eosinophiles, 3 per cent Urinalysis showed clear urine, reaction, acid, albumin, 0, sugar, 0, blood, 0 The von Pirquet was negative Roentgen ray examination of the abdomen showed all shadows obscured by a large opaque shadow occupying the entire left abdomen

Operation (Dr A F M) August 30 1923 (ether anæsthesia) Exploratory operation only was done The child died August 31 1923

Autopsy was done 3 hours after death The anatomic diagnosis was bilateral embryonal adenomyosarcoma (huge of the left kidney and slight of the right kidney) abdominal viscera displaced to the right, pressure atrophy and partial hydronephrosis of the left kidney, recent surgical abdominal exploratory operation wound generalized anemia hyperplasia of the thymus spleen, and lymphoid tissue of the lining of the bowel hypostatic hyperemia and edema of the lungs slight hypostatic bronchopneumonia, cloudy swelling of the liver and right kidney, fatty changes of the liver and right kidney dry and crusted lips unequal pupils undescended testicles, partial congenital sinus of the right ureter, accessory spleen

The essential autopsy findings were the patient was a 5 months old boy weight 12 5 pounds and height 62 5 centimeters A huge, solid tumor was present in the left kidney which weighed 545 grams and displaced the abdominal viscera to the right A second tumor of the lower pole of the right kidney was pale gray and sharply defined in marked contrast to the adjacent compressed kidney There was no evidence of metastasis anywhere in the body

Microscopic examination of the kidney tumors revealed dense epithelial cell nests rather dense epithelial stroma tubules both in epithelial cell nests and solitary in the loose stroma The tubules were sharply defined and were very similar to those of a normal kidney Compression atrophy of the kidney center liquefaction necrosis, and dense masses of sharply defined striated and non striated muscle fibers were noticeable

CASE 5 R F female white aged 5 years, was admitted to the Children's Memorial Hospital on the service of Dr S J Walker December 22, 1914, with the history that 4 months before admission to the hospital that is when the child was about 4½ years old she ran along the top of a wall and fell to the ground striking her abdomen against the wall After this the mother noticed a small hard lump a little larger than a hen's egg in the abdomen Two days after the injury the child vomited a good deal Subsequently a large hard swelling developed in the abdomen which increased rapidly in size The child was constipated and bowel movements were painful There have been no urinary symptoms, no history of blood in the urine or feces During the 2 years before admission the child had lost some weight There was pain in the abdomen which was most marked in the left side and the pain was worse at night Physical examination disclosed a rather poorly nourished but well developed child, able to walk about the ward with comfort The skin had a sallow, tan color The teeth were in poor condition The heart was normal except for a systolic murmur The lungs were negative In the abdomen was a marked enlargement due to a tumor mass Veins over the entire abdomen were large The

suprapubic region and the lower right iliac region were the only places free from this mass In the right upper quadrant there was felt an oval mass about the size of a fetal head approximately 10 by 10 centimeters This mass had a cystic feel and was surrounded by an area of comparative tympany The mass moved partly with respiration There were a few enlarged anteroposterior cervical and submaxillary lymph glands as well as a few palpable inguinal glands The veins of the extremities were prominent Temperature on admission was 101 degrees Blood examination revealed red blood cells, 4,160,000, white blood cells 8,200, hæmoglobin 80 per cent stained blood smears were negative The blood Wassermann test was negative Urinalysis revealed reaction, acid, albumin +, sugar, 0, sediment few white blood cells, and few hyaline casts The phthalein test showed 30 per cent secretion in 2 hours Cystoscopic examination of the bladder was negative The ureteral catheter met an obstruction on the left side Three catheters were passed into the ureter for about ¾ inch beyond which point catheters could not be advanced A pyelogram was attempted through this catheter but the fluid failed to reach the kidney

Pre-operative diagnosis malignant tumor of the kidney

Operation (Dr B) January 7, 1915 (general anæsthesia) A right nephrectomy was done The child died, January 28 1915

The surgical specimen consisted of the kidney and its adherent tumor which together weighed 265 grams The kidney was essentially of uniform, globoid shape with lobules elevating the surface capsule The tumor arose centrally in the kidney and by its growth pushed the normal kidney outward The kidney tissue which remained was sharply defined definitely separated from the tumor, and the kidney was so compressed in places that it was only 3 to 4 millimeters thick The tumor itself consisted of lobules 5 to 20 millimeters in diameter which were gray to pink, firm and of even consistency throughout The lobules were separated from each other by fibrous bands and in several of these lobules there were dark red to black, soft friable portions 1 to 3 centimeters in general diameter

Microscopic examination revealed dense epithelial cell nests with large nuclei which were coarsely granular, the epithelial cell nests had isolated tubules in their centers and elsewhere the central walls of the epithelial cell nests were clumped or agglutinated together as in the formation of new tubules Fibrous bands ramified throughout the tissue Solid strands of striated muscle fibers were present throughout the diffuse loose stroma

CASE 6 W A, male white, aged 3 months admitted to the Children's Memorial Hospital on the service of Drs Buford and Walker, July 1, 1915 The present illness began 6 days ago with anorexia vomiting, crying, fever, and constipation He had always slept well until the night before admission to the hospital Apparently he was in a good deal of

pain most of the time. No convulsions and no urinary symptoms were revealed. He had vomited every day since the onset of the illness up to and including the day of admission to the hospital. Physical examination revealed a rather poorly nourished child, who cried a good deal. The entire surface of the body was covered with a fine petechial rash. The heart and lungs were negative. Very prominent superficial veins were noticeable on the abdomen which was rigid. A large tumor mass was palpated on the right side. The mass was round in outline, hard in consistency, and well defined, extending from beneath the costal arch into the inguinal region and into the midline as far as the umbilicus.

Rectal examination revealed the lower pole of the tumor mass extending to the right side of the pelvis. During the time in the hospital, the highest temperature was 99.2 degrees, and this occurred only once, twice the temperature was 99 degrees. Blood examination revealed white blood cells, 28,650, polymorphonuclear neutrophils, 46 per cent, small lymphocytes, 54 per cent. The blood Wassermann was negative as were those of the father and mother. The Von Pirquet was negative. Urinalysis disclosed turbid urine, reaction, acid, albumin, +, sugar, 0, sediment, 0. The phthalein test showed only the slightest trace of dye at the end of a 2 hour period of collection. Roentgen ray examination of the abdomen after bismuth feeding revealed the stomach displaced to the left and most of the intestines in the left side of the abdomen, the liver and tumor occupying the whole right side as evidenced by a shadow that extended from the fifth rib into the groin.

The child died, July 13, 1915, without operation.

Autopsy (Incision of the abdomen only was allowed.) The body was that of a moderately emaciated white boy 18 inches tall. There was a marked protuberance of the upper right quadrant of the abdomen. Here there was a large, hard, irregular mass which extended from the costal arch above to the right anterior iliac spine and to a little left of the midline of the abdomen. The mass was lobulated and slightly movable. When the abdomen in the region of the tumor was opened there was found a lobulated mass the size of the patient's doubled fists, occupying the right kidney region. Across the lower median pole there was a loop of small bowel, but this was not adherent to the tumor mass. The fibrous capsule of the mass was opened and the tumor was easily shelled out. The right adrenal gland was in normal position and was not enlarged. The right ureter was twice as large as the left, but its pelvis was not distended. A fine probe was passed from the bladder to the right ureter, and an obstruction was met a short distance from the bladder. The left ureter was patent. The left kidney had a dime sized subcapsular hemorrhage. The surfaces made by section were hyperemic and were without pathological change. The left adrenal was like the right in all essentials. The lining of the

urinary bladder was enlarged. On section of the tumor mass there were found many soft lobulations from which a pink fluid was expressed. The arrangement of these friable masses in general corresponded to the markings of a kidney, but only slightly so. Beneath the capsule there was a thin structure surrounding the entire mass which resembled the cortex somewhat. There were a few cavities throughout the mass which contained pink-yellow semi fluid. The liver, spleen, and gastro intestinal tract were unchanged.

Anatomic diagnosis: sarcoma of the right kidney, occlusion of the right ureter.

The preserved right kidney mass weighed 295 grams, the left kidney, 13 grams (Fig. 4). The left kidney was normal in all essentials. The right kidney mass measured 11 by 7 by 8 centimeters. It was everywhere encapsulated, its surface was irregular due to nodulations 1 to 3 centimeters in general diameter as measured on the surface. On 6 surfaces made by cutting, at least $\frac{2}{3}$ of the entire mass was of tumor tissue. These surfaces were uniformly smooth glistening, and uniformly firm. These surfaces consisted of single nodules 5 by 8 millimeters in general diameter to conglomerate masses 3 to 3.5 centimeters in diameter. These conglomerate masses were largely of the upper pole. An irregular mass of the lower pole about 3 centimeters across was dark brown, glistening, lobulated and had a suggestion of striations of the cortex and pyramidal portion. It cut with the consistency of the normal kidney. It was the only structure which grossly resembled what was left of this kidney tissue. The tissue between the light brown to gray fibrous like tumor nodulations, was soft, friable, dark brown, and brown black stippling as in old blood exudation. On close inspection this internodulation tissue resembled compressed kidney tissue. All sections made by cutting were similar. The pelvis of this right kidney and the tumor mass were not a single sac, but rather consisted of irregularly dilated sacculations some of which were 1 centimeter in circumference. These sacculations were normally thin walled, had glistening linings, and these were irregularly fused to converge at the ureter, which was 3 millimeters in circumference and grossly resembled the left ureter in all essentials. In the lower pole, between the kidney tissue and the tumor tissue, three sacculations of this pelvis measured 3 to 10 millimeters long and 2 to 5 wide. These were the only places where the pelvis was distended. (Drawings were made to show the gross appearance of the right kidney tumor mass in relative size to the normal left kidney.)

Microscopic examination showed large clumps of loosely packed epithelial cells in a fibrous reticulum. New tubules were abundantly present in the peripheries of the epithelial cell masses. The tubules were of irregular shape and in general were larger than a normal tubule, they were sharply defined. Tubules were present both within the cell nests and in the loose stroma in such huge number that 36

were counted in a single low power field. Elsewhere there were masses of large epithelial cells clumped together in their central portions as in the formation of new tubules. Single strands of striated muscle fibers were present, but thick bundles of non-striated fibers were abundant. There was diffuse anemic compression necrosis with focal suppuration.

CASE 7 I O male white aged 6½ years, was admitted to the Children's Memorial Hospital on the service of Dr Gustav Kaufmann March 10 1919. Two weeks before admission the child suddenly complained of severe pain in the right side of the abdomen following a bowel movement. He was nauseated and vomited. Temperature rose to 103 degrees. The temperature nausea and vomiting persisted for several days. Physical examination disclosed a decidedly anemic child who was apparently in great pain. The pupils reacted to light. The teeth were in poor condition. The tongue was very red, the tonsils enlarged and reddened. The neck showed moderate lymphadenopathy. The chest had a marked rachitic rosary. The heart disclosed a roughened first sound at the apex which was transmitted to the axilla and toward the base. The lungs were negative. A bulging tumor mass was noticeable in the right upper quadrant. It extended just a little beyond the midline and about one third of the distance between the costal arch and the crest of the ilium and did not move with respiration. A peculiar crepitant sensation was elicited upon palpation. The records stated that this was like a subcutaneous emphysema. Temperature on admission was 103 degrees and came down to normal in 72 hours. Following the operation temperature rose to 104.5 degrees. Blood examination revealed red blood cells 26,000 white blood cells 22,700 polymorphonuclear neutrophils 85 per cent, small lymphocytes 4 per cent, large lymphocytes 4 per cent, transitional 3 per cent, myelocytes, 4 per cent. Urinalysis showed reaction acid, albumin +, sediment, white blood cells. Many urinalyses showed the presence of albumin but no casts. Koentgen ray examination of the colon by air inflation showed the ascending and transverse colon above the tumor mass. The previously felt crepitation had disappeared.

Operation (Dr B) March 13 1919 (ether and nitrous oxide). Exploratory laparotomy in the midline was done. The peritoneal cavity was negative. A large retroperitoneal tumor mass was found in the right kidney area. The abdominal incision was closed and a right posterior incision made. A nephrectomy was done.

The postoperative course was complicated by diphtheria and measles. Examination by Dr H. Helmholtz May 15 1919, revealed the presence of a palpable mass in the right kidney region. Patient developed a bronchopneumonia on May 19 1919. Great abdominal distention developed, May 28, 1919. Patient was taken away from the hospital May 28 1919 against advice. He was cyanotic, respiration was labored, the abdomen was greatly

distended and signs of fluid were noticeable in the abdominal cavity.

Death occurred 4 days after being taken home.

The surgical specimen consisted of the kidney and its attached tumor which together weighed 165 grams. The tumor arose centrally within the kidney and pushed the kidney tissue outward with compression of its opposite poles. The kidney tissue present was dark brown and sharply demarcated from the light gray pink tumor tissue. The tumor was of uniform consistency soft compressible except for soft friable, porous places which were dark red to black.

Microscopic examination showed that the kidney was normal except for tubular degeneration. Between the kidney and tumor was a fibrous reticulum containing lymphocytes then a dense cell mass of small epithelial cells and leucocytes. The next layer was a pale stained necrotic mass of tissue which stained with eosinophile only except for isolated leucocytes which were blue with hematoxylin. The tumor itself consisted of dense epithelial cell nests and loose cell masses of epithelial cells with isolated tubules in the cell nests and in places there was an agglutination of cells in the central portions of the epithelial cell nests forming tubules. Between lobules there were masses of tissue of compression anemic necrosis portions of which contained disintegrated leucocytes.

CASE 8 R W, male, aged 2½ years admitted to the Presbyterian Hospital on the service of Dr C. C. Grulee January 5, 1925 with the complaint of a mass in the abdomen. Six weeks ago while the child was standing up the mother noticed the presence of a swelling the size of an orange in the left upper quadrant. This mass had gradually increased in size growing toward the midline. For the past 6 months he had had difficulty in passing urine in that it was necessary for him to strain considerably at each urination, but pain was absent. He voided several times a day in large amounts. No blood was found in the urine at any time. He had slept well and had lost no weight. Physical examination by Dr C. C. Grulee revealed a well developed and well nourished child. The head and neck were negative except for slightly enlarged tonsils. A few enlarged, shotty glands were felt in the posterior triangles of the neck. There was slight dullness in the left lower lobe of the lungs posteriorly and the excursion of the diaphragm was limited. A mass was felt in the left upper quadrant extending well below the umbilicus below and 2½ inches beyond the midline to the right. The tumor was firm and smooth except for an apparent lobulation above the midline. The external genitalia were negative as were the extremities. Blood examination showed red blood cells 4,280,000, white blood cells, 6,600, haemoglobin, 85 per cent. Urinalysis showed reaction acid, albumin, 0, sugar, 0, blood, 0, bile, 0, sediment 0. Cystoscopic examination showed the bladder to be normal. The ureters were normal and could be catheterized without difficulty or obstruction.

Urine from the right and left kidneys and bladder were sterile and free of pus. Indigocarmine test showed a concentrated discharge of blue urine from the right side in 10 minutes and a very dilute pale blue urine from the left side in 15 minutes. Recent gen. ur. examination disclosed a dense shadow involving the greater part of the left side of the abdomen. Pyelogram of left side was normal. Preoperative diagnosis in spite of the fact that the left pyelogram was normal a diagnosis of malignant tumor of the left kidney was made and operation was advised.

Operation (H. L. K.) January 12, 1925 (ethylene anesthesia). Through the usual oblique kidney incision a left nephrectomy was done.

Recovery was uneventful and patient was discharged, January 30, 1925.

The surgical specimen consisted of the entire kidney mass which weighed 204 grams (Fig. 5). In general it was pear shaped, the stem portion consisting of grossly normal kidney, the base of which flattened out broadly into the huge tumor mass, from which the kidney was separated by fibrous bands. Approximately $\frac{1}{2}$ to $\frac{1}{3}$ of this original kidney was present. Its cortex was easily 2 to 3 millimeters wide. Its striations were normally present in relation to the medullary portion. The entire mass was normally encapsulated. This capsule readily stripped off from the kidney proper, but where the kidney was flattened out to blend into the broad tumor mass, the capsule was rather firmly adherent and took fine shreds of tumor tissue with it when separation of the capsule and the tumor was attempted. After removal of the capsule, however, the general surface was found to be essentially smooth and light gray to light brown, in sharp contrast to the adjacent dark brown kidney tissue.

On surfaces made by cutting, about $\frac{1}{3}$ of the tumor mass was found to be rather firm and in places friable. It was light gray to brown and of essentially equal consistency, centrally as peripherally. The remaining $\frac{2}{3}$, which was of the lower pole, was soft and mushy, it was lighter gray and putty like in consistency. Here pressure necrosis was definite.

Microscopic examination showed dense epithelial cell nests with large, coarsely granular nuclei which were vacuolated, the nests contained huge, well formed tubules, some of which were in the process of formation. The nests were separated by fibrous tissue strands and in some of these nests there were masses of disintegrated leucocytes. Tubules were abundant. There were masses of pale stained, epithelial, cellular stroma of compression necrosis, many non striated muscle fibers, solitary single strands of striated muscle fibers, dense fibrous stroma in which were scattered large epithelial cells with coarsely granular vacuolated nuclei.

CASE 9 B. B., male, white, aged 19 months, admitted to the Children's Memorial Hospital on the service of Dr. Charles Schott, November 13, 1924. The present complaint was a large mass in

the abdomen. As far as the father knows, the child was perfectly well until about 2 months before admission when he became very nervous, developed a poor appetite, and did not appear to be well. He also began to lean forward when urinating. He was taken to a physician who advised circumcision, and this was done. A week following the circumcision, or 4 weeks before admission to the hospital, the mother found a mass in the left side of the abdomen. No urinary symptoms. The child had had some fever off and on since the circumcision. Physical examination by Dr. C. Schott revealed a fairly well developed, rather poorly nourished child who did not appear acutely ill. The chest was moderately emaciated and presented a slight Harrison's groove and rachitic rosary. The lungs were negative. The heart was negative. The abdomen disclosed a bulging of the left flank. A very large hard tumor mass filled the whole left flank, and the whole abdomen to the left of a line about 1 centimeter to the right of the left nipple. The mass was regular except a protuberant portion about 1 inch above the umbilicus which extended from the tumor mass proper to the midline of the abdomen. It was hard and was attached to the main tumor, about 2 centimeters across. It was possible to palpate between the tumor and the costal margin from the anterior axillary line to the right. The mass was not tender, and the skin was not discolored. The liver and spleen could not be felt. The external genitalia were negative.

A second examination by Drs. Schott and Brenne-mann verified these findings. Rectal examination showed a tumor mass palpable and extending down into the pelvis. The lower pole was smooth, rounded, and not tender. Colon inflation revealed the colon passing over the tumor mass. Temperature on admission was 99 degrees and never went higher. Blood examination showed white blood cells, 6200, hemoglobin, 75 per cent. The nasal and throat cultures were negative. Fluoroscopic examination with barium verified the previous colon examination. Roentgen ray examination showed the chest to be negative for evidence of metastasis. The abdomen following barium enema showed a filling defect in the descending colon which was accounted for by intra abdominal pressure.

Pre operative diagnosis sarcoma of the left kidney. Operation was advised.

Operation (Dr. E. M. M.) November 21, 1924 (ether anesthesia). Nephrectomy was carried out. Patient died on the table.

Autopsy (Autopsy examination was made through the surgical wound only.) The anatomic diagnosis was mixed cell tumor of the left kidney with abdominal content displaced to the right, acute anemia, emaciation. The organs were all found to be grossly normal and nowhere were there any metastases present either in the lungs or abdominal cavity.

The right kidney was normal in every respect and weighed 63 grams. The surgically removed left kidney and its adherent tumor together weighed 675

grams The tumor arose centrally and compressed the kidney outward so that the kidney itself was sharply defined from the tumor mass from which it was separated by fibrous bands and was essentially a nub of kidney tissue, the main portion of which measured about 2 by 3 by 1.5 centimeters and thinned out to newspaper thickness at the tumor margin The tumor itself was firm to hard of uniform consistency throughout When cut across in several places it was found to be lobulated in places 2 to 3 centimeters in diameter and the lobules were gray to pink and some contained dark red to black, soft friable spots

Microscopic examination revealed a loose stroma hugely infiltrated with epithelial cells in an even arrangement but in portions of the sections larger epithelial cells were arranged in nests containing indistinct partially formed new tubules Through out the epithelial stroma there were solitary fibers of striated muscle In multiple places there were compression necrosis and masses of disintegrated leucocytes and debris

CASE 10 L J W female, white aged 13 months was admitted to the Children's Memorial Hospital on the service of Dr Joseph Brennemann October 8, 1928 The parents stated that the baby had always had a very large prominent abdomen and that this had been noticed since she was about 1 month old They did not attach importance to this enlargement until the baby was 13 months old when they took her to a doctor because it was their impression that the abdomen was growing larger than the rest of the body The doctor made light of the mother's story and expressed the opinion that the baby would outgrow the condition Another doctor was consulted and a diagnosis of tumor of the kidney or enlarged spleen was made On several occasions the mother noted blood in the bowel movement There were no urinary symptoms Physical examination by Dr J Brennemann disclosed a well nourished child with a strikingly large abdomen The tonsils were enlarged On the left side of the abdomen was a large mass which was firm, movable and not nodular and occupied practically the whole of the left side of the abdomen extending well back into the flanks There was a small tubular mass just to the left of the navel above the other mass Blood examination revealed red blood cells 6,330,000, white blood cells, 14,840, haemoglobin, 60 per cent polymorphonuclear neutrophils, 30 per cent, lymphocytes, 66 per cent, eosinophiles 4 per cent Urinalysis showed reaction, acid, albumin, + sugar, 0 sediment much amorphous material Fluoroscopic examination, with barium meal, showed the intestines anterior to the mass and very close to the abdominal wall Roentgen ray examination showed that no evidence of metastasis was present in the chest Cystoscopic examination revealed a normal bladder Both ureters were catheterized without difficulty or obstruction The urine from the right kidney was normal No urine was obtained from the left side Pyelograms were made and the right was normal

On the left side, the bromide solution met an obstruction at the ureteropelvic junction, hence no pyelogram was obtained The filling defect was due to a tumor

Pre-operative diagnosis malignant tumor of the left kidney

Operation (H L K) October 18 1928 (ether anaesthesia) The usual oblique kidney incision was made, and the tumor was delivered through the wound, the ureter being clamped and divided The renal pedicle was clamped and ligated The usual wound repair (Fig 6) was carried out The post operative course was uneventful Since leaving the hospital the patient has had two courses of deep X ray treatment Examination showed no sign of recurrence A recent examination, November 12 1929, showed no sign of recurrence and the patient is perfectly well 1½ years after nephrectomy

The surgical specimen consisted of the kidney and its adherent tumor which together weighed 78.5 grams Only a small portion of the kidney had not been obliterated by compression The tumor itself was of uniform, firm consistency, in general it was semi spherical about the size of a grapefruit When cut across it was found to be firm to hard of even consistency throughout It was easily shredded and generally gray tinged with pink

Microscopic examination disclosed marked compression atrophy with extensive tubular degeneration, diffuse epithelial cell stroma with clumps of epithelial cells of nest like structure The nuclei of the epithelial cell nests stained deeply, but the epithelial cells in the stroma had large nuclei which were finely granular and contained vacuoles Elsewhere throughout the tumor tissue the epithelial nests were abundant, compact, together and in their central portions retained many new tubules Adjacent to isolated cell nests were striated muscle fibers usually in single strands

CASE 11 A G, male, aged 6 years admitted to the Children's Memorial Hospital on the service of Dr A H Montgomery, April 28, 1927 Two months before admission to the hospital the patient fell down striking his left side against a bench Pain was present in the side for about a fortnight and then disappeared Pain recurred in the left side 3 days before entering the hospital, at which time a very large swelling was noted A doctor was called and found the presence of a large, left upper quadrant tumor He aspirated the stomach but no pus or fluid was obtained The appetite was good The bowels were normal, urination was normal Physical examination disclosed a fairly well developed and well nourished child The head, neck, nose throat heart, and lungs were negative In the abdomen was a very large, firm tumor in the left upper quadrant extending into the right half of the abdomen in the region of the umbilicus down to within 1 centimeter of the crest of the ilium on the left The tumor was movable, had definite borders, and a notch could be felt along the superior surface No tenderness was elicited on palpation Blood exami-

nation showed red blood cells, 4,200,000, white blood cells, 12,200, hæmoglobin, 80 per cent. Urinalysis disclosed reaction acid, albumin, 0, sugar, 0, casts, 0, leucocytes, 0. Roentgen ray examination showed a very large tumor mass extending from the region of the left kidney, beyond the midline and down into the iliac fossa. Examination of the abdomen by H. L. K. disclosed a large, hard, irregular, movable tumor which extended beyond the umbilicus. A notch could be felt. The lower edge was smooth and hard.

Pre operative diagnosis sarcoma of the left kidney.

Operation (Dr. A. H. Montgomery) May 19, 1921 (ether anesthesia). Exploratory laparotomy was performed, and a section was removed for histological study. The wound was closed. Patient left the hospital on June 11, 1921, with condition unchanged, and died.

Microscopic examination of the specimen removed showed fibrous tissue stroma containing isolated epithelial cell nests in which were new tubules. Isolated tubules were also present out in the loose stroma.

CASE 12 J. B., male, white, aged 1 year, was admitted to the Presbyterian Hospital on the service of Dr. H. L. Kretschmer, July 17, 1929. The present complaint was enlargement of the abdomen and a tumor mass on the right side. Six weeks before admission to the hospital when bathing the child the mother noticed that the abdomen seemed large. Her mother in law felt the abdomen and noticed a very hard, nodular mass in the right hypochondrium. The mass was not painful and increased in size very slowly until 2 weeks ago, when growth was rapid, the tumor extending from the costal margin to the crest of the ilium. No urinary symptoms were present and there was no blood in the urine. Physical examination disclosed a fairly well developed and well nourished child with head, neck, heart, and lungs negative. A large tumor was found in the right upper quadrant, extending from the arch of the rib down to the crest of the ilium and 2 fingers breadth beyond the left of the umbilicus. The mass was firm, smooth, elastic, and freely movable, the borders were easily palpable. Blood examination showed red blood cells, 4,000,000, white blood cells, 16,200, hæmoglobin, 68 per cent. Wassermann and Kahn tests were negative. Blood chemistry examination (before operation) showed urea nitrogen, 23.4, uric acid, 5.0, creatinin, 22, total nonprotein nitrogen, 41.7. Four days after operation Urea nitrogen, 100, uric acid, 9.1, creatinin, 43, total nonprotein nitrogen, 126.9. Urinalysis showed reaction, acid, sugar, 0, albumin +, blood, 0, red blood cells, rare, leucocytes, rare. Roentgen ray examination disclosed a uniform dense shadow over the right half of the abdomen. Cystoscopic examination revealed a normal bladder. Ureteral catheters were passed without difficulty or obstruction. Pyelograms were made and showed the left side normal. The right ureter was displaced to the left side of the abdomen,

the malposition beyond the midline being apparently due to the large tumor. No fluid entered the right kidney pelvis. Fluoroscopic examination (barium meal) showed the right half of the colon displaced to the midline.

Operation (H. L. K.) July 21, 1929 (ether anesthesia). A right nephrectomy was done.

The right kidney after excision weighed 514 grams (fig. 7). It was encapsulated and in general was of kidney shape. Its surface generally was smooth. On 7 transverse sections made by cutting, about half of the surfaces were light gray, and the other half dark red to brown. The light gray portions consisted of tumor nodules, the largest of which measured 32 centimeters in diameter. These nodules were of even consistency centrally and peripherally, they were firm to hard and in sharp contrast to the adjacent light brown compressed kidney tissue remnants. This kidney tissue had a suggestion of cortex with striations and a few definite pyramids. The nodules were conglomerate but each nodule was separated from its neighbor by a firm, fibrous tissue band. In the lower pole where the mass was broadest, adjacent to the light gray nodules, there was dark red to brown, soft, friable tissue resembling compressed necrotic kidney tissue. Portions of compressed pyramids were definite, and from these places delicate, compressed bands of this kidney tissue extended out into the tumor mass between the nodules of tumor tissue which here were firm and pearl gray.

Microscopic examination of the surgical specimen showed loose stroma, widely surrounding epithelial cell nests, new tubules, both in epithelial cell nests and in loose tissue, stroma bundle present, isolated striated muscle fibers.

Following the operation the child developed complete anuria. The left kidney was enlarged and tender. An indwelling ureteral catheter was left in place for 24 hours. A prompt flow of urine was obtained. Following the removal of the ureteral catheter the patient again developed anuria and the left kidney again increased in size. Blood chemistry examination at this time showed 133 milligrams of urea nitrogen.

Second operation (H. L. K.) July 29, 1929, pyelotomy and decapsulation done. The kidney was pale, slightly enlarged, and free of tumor. Following the operation the urinary secretion started immediately, and 6 days later the urea nitrogen dropped from 133 milligrams to 29.1. The child made an uneventful recovery and was discharged, August 20, 1929, 22 days after the decapsulation and pyelotomy.

On September 23, 1929, 2 weeks prior to second admission the parents discovered the presence of a tumor mass in the left upper quadrant. One week prior to admission all of the urine was passed through a fistulous opening in the loin and no urine was passed through the urethra. Examination of abdomen revealed a fistulous opening in the nephrectomy scar and the presence of a mass the size of a small grapefruit in the left upper quadrant.

Third operation (H L K.) September 24 1929 (ether anaesthesia) An incision through the old scar was carried down through the skin and abdominal muscles. A large tumor involving the remaining kidney was found. It consisted of two or three independent masses that were irregular exceedingly hard, and resembled in their gross appearance the tumor that was found on the opposite side. Histological examination of sections removed showed adenomyosarcoma.

The patient left the hospital October 18 1929 and was given 11 deep X ray treatments. The child failed rapidly and died on December 22 1929.

Resume This patient had a bilateral Wilms tumor. Interesting is the rapidity with which it developed in the remaining kidney, which had been operated upon July 20 1929 because of anuria, though at the time there was no indication of a tumor. However at the third operation September 24 1929 a large Wilms tumor involving the remaining kidney was found, its development covering only 3 weeks.

Autopsy There was a huge extension of tumor tissue filling the cavity of the surgically removed kidney with extensive infiltration into the liver and left kidney. There were multiple tumor nodule metastases to the lungs. Extensive tumor infiltration of all the loose peritoneal tissues and tumor compression of the pancreas.

The left kidney weighed 470 grams (Fig 7) and at least 9/10 of it was replaced by new tumor tissue which was smooth homogeneous gray to light brown firm to hard kidney tissue which was present was dark red brown. The left kidney was definitely involved by infiltration rather than by origination of the tumor in the left kidney and subsequent compression of the kidney.

Microscopic examination of the left kidney revealed left diffuse compression atrophy and tubular degeneration. Compression necrosis, loose stroma containing epithelial cell nests most of which contained single new tubules or clumps of tubules. Tubules both inside of nests and out in loose stroma isolated striated muscle fibers, the loose stroma adjacent to the kidney retained tubules but no epithelial cell nests here. The epithelial cell stroma contained large pale nuclei and in places the stroma contained only small nests and only partially developed tubules. Throughout the tumor there were strands of fibrous reticulum with clumps of lymphocytes. Elsewhere there was diffuse compression necrosis. The liver (Fig 16) showed extensive tumor infiltration of loose epithelial stroma. Epithelial cell nests and abundant sharply defined, new tubules and isolated striated muscle fibers. The lung (Fig 17) showed that the nodules consisted essentially of loose epithelial cell stroma and small clumps of cells in a circular arrangement. The cells invaginated in folds which were apparently at tempts of tubular formation.

CASE 13 G F male white aged 5 years was admitted to the Presbyterian Hospital on the service

of Dr H L Kretschmer April 28, 1924. The present complaint was a large swelling in the left side of the abdomen. The nurse stated that the child had always been well until 4 months before admission to the hospital, when he became restless lost his appetite, and decided indications were apparent that his condition was subnormal. Shortly before Christmas (1923) he complained to the nurse that he had an ache in his side. The tumor mass was first noticed by the mother about 6 weeks ago. The mass had been growing progressively larger since that time. He had marked loss of weight and appetite. Pain and urinary symptoms were absent. Physical examination disclosed a small pale and anæmic child indicating undernourishment and poor muscular development. The head and neck were negative. The chest had decidedly limited expansion. The left lung was relatively duller posteriorly than the right. There was a sharp flare of the left costal arch due to the abdominal tumor. The heart sounds were clear and rapid, some accentuation of the aortic sound. A large tumor mass occupied the entire left half of the abdomen, extending up beyond the left costal arch and downward into the left iliac fossa well below the crest of the ilium and to the right to the anterior axillary line. There was no notch. Blood examination showed red blood cells 3,900,000 white blood cells 22,000, haemoglobin 85 per cent. Urinalysis showed reaction, acid, albumin, +, sugar, 0, blood 0, bile 0, sediment casts 0, red blood cells 0, and a few leucocytes. Cystoscopic examination was negative. The ureters were catheterized. No urine was obtained from the left side. The urine from the right side and from the bladder was sterile, no pus. The phthalein test showed 31 per cent of phthalein excreted from the right kidney in 30 minutes, no excretion from the left kidney. Roentgen ray examination was negative for stone. Pyelograms were made. No fluid entered the left kidney pelvis because of obstruction due to the tumor.

Pre operative diagnosis malignant tumor of the kidney.

Operation (H L K.) April 29 1924 (ether anaesthesia). An enormous solid tumor mass was found very vascular and firmly fixed, with large dilated vessels. Several sections were removed for histological study. The wound was closed without attempting to remove the tumor mass. The child left the operating room in poor condition. It was felt that because of the large size of the tumor and its firm fixation, and also because of the poor condition of the child, a nephrectomy was out of the question.

The postoperative course was uneventful. Patient left the hospital May 6, 1924.

Microscopic examination showed epithelial cell masses spindle shape cell masses containing new, sharply defined tubules dense epithelial cell nests containing new, sharply defined tubules diffuse fibrous tissue hyperplasia containing solitary epithelial cells with large, pale coarsely granular

nuclei, isolated indistinct single strands of striated muscle fibers, extensive necrosis and compression atrophy with focal masses of disintegrated leucocytes

CASE 14 F L, male, white, aged 2 years, was admitted to the Presbyterian Hospital on the service of Dr Arthur Dean Bevan, March 23, 1921. The present complaint was tumor of the abdomen. Two months ago the mother noticed that the child's abdomen was rather hard and large, but thought it not unusual. Three weeks prior to admission to the hospital he had a fall, bumping his right side on a sharp corner. Following this, his nurse noticed an enlargement of the right side of the abdomen. The mother was under the impression that the child lost some weight during the past 2 weeks, due to dieting. There was no history of pain or frequency or the presence of gross blood in the urine. Physical examination showed the head, neck, heart, and lungs to be negative. A very large tumor was found in the right side which was movable and had a dull note on percussion. Blood examination showed white blood cells, 8,300, hæmoglobin, 65 per cent. Urinalysis showed reaction, acid, albumin, o, sugar, o, blood, o, bile, o, sediment, casts, o, occasional red blood cell and a few leucocytes. Fluoroscopic examination of the gastro intestinal tract was negative. Roentgen ray examination was negative.

Pre operative diagnosis tumor of the kidney.

Operation (Dr A D Bevan) March 25, 1921 (gas and ether anaesthesia) Right nephrectomy was done.

The postoperative course was uneventful and patient was discharged from the hospital, April 6, 1921.

Microscopic examination showed a fibroblastic stroma, loose undifferentiated cell stroma, which elsewhere was in dense clumps containing indistinct new tubules and clumps of cells in the formation of new tubules. The undifferentiated cells had huge nuclei with sparse coarse granules in them, isolated, smooth muscle fibers and striated muscle fibers, fibrous tissue masses containing large epithelial cells.

CASE 15 G B, male, white, aged 7 months, admitted to the Presbyterian Hospital on the service of Dr Allen, June 24, 1917. The present complaint was a large mass in the abdomen and constipation. Two and a half weeks prior to admission to the hospital the mother noticed the presence of a mass in the abdomen. Previous to this time patient had been perfectly well. Constipation had been present for about a week. He had not lost weight or appetite, he had no urinary symptoms, but a slight afternoon temperature up to 101.2 degrees. Physical examination disclosed a well nourished and lively child with head, neck, heart, lungs, and extremities, negative. In the abdomen on the left side was a mass the size of a grapefruit, firm in consistency, smooth, and fairly movable, but not tender. The testes were not descended. Blood examination showed white blood cells, 8,500. Urinalysis showed reaction, acid,

albumin, o, sugar, o, bile, o, sediment, casts, o, blood, o, few leucocytes.

Operation (Dr A D Bevan) March 26, 1917 (ether anaesthesia) Left nephrectomy was done.

The postoperative course was uneventful and patient left the hospital, July 7, 1917.

Microscopic examination showed massive epithelial cell nests with a huge number of large, sharply defined, new tubules both in the nests and out in the loose stroma, striated muscle fibers abundantly ramifying throughout the epithelial cell nests and fibroblastic stroma.

CASE 16 D S, male, white, aged 3 years 10 months, was admitted to the Presbyterian Hospital on the service of Dr C G Grulee, July 16, 1919. The present complaint was general weakness, pain on the right side, and stomachache. About 5 weeks before admission to the hospital, while walking down the street he fell. He complained of pain in the right side and was carried home. He had been in bed most of the time since. On rare occasions he walked about the room, but seemed very tired. A few days after the fall the mother noticed the presence of blood in the urine, which had been present in varying amounts. At times the urine appeared free of gross blood. He had pain in the side almost continuously, pain in the left side occasionally. Urinary symptoms were absent. Physical examination disclosed a well nourished child who did not appear ill. The temperature was normal. The head and neck were negative. The chest, heart, and lungs were negative, except bronchial gland dullness extending to the third spine. The abdomen was very protuberant, more so on the right side than on the left. There was a hard, resistant tumor mass in the right upper quadrant that extended from the costal margin in a line 2 inches from the midline down to the level of the anterior superior iliac spine back to the spine in the lumbar region. The liver was palpable, being pushed over to the left. The spleen was not palpable. The left kidney was not palpable. The external genitalia were negative. Blood examination showed red blood cells, 4,050,000, white blood cells, 9,900, hæmoglobin, 85 per cent. Urinalysis disclosed reaction, acid, albumin, trace, sugar, o, sediment, occasional hyaline and granular casts, blood, trace, many leucocytes. The Von Pirquet was negative. Cystoscopic examination revealed the bladder negative, the ureters normal, no obstruction, and urines from the right and left kidneys sterile and free of pus.

Operation (H L K) July 19, 1919 (ether anaesthesia) A right nephrectomy was done. The tumor was unusually large, was surrounded by many large blood vessels, and there was much bleeding due to the presence of these enlarged veins. The tumor was delivered with great difficulty, the pedicle isolated, clamped, and ligated, and the kidney and the tumor were removed. The patient left the table in very poor condition due to shock. Patient died that night. Permission to obtain an autopsy, unfortunately, was not granted.

The surface of the specimen removed was irregularly nodular in the lower half and fairly smooth in the upper half. The lower half seemed to be made up of many small nodules. One large nodular mass was situated on the convex border. On the surface of the upper part were seen many small nodules distinct and isolated.

Surface made by cutting showed a very small amount of kidney tissue left, which formed a band at the outer side varying in thickness averaging 2 centimeter. The lower half of the tumor was hard and solid. The nodules were white in color with here and there a yellow tinge which seemed to be more marked in what appeared to be fibrous tissue. In the middle of the tumor, just under the surface was a large yellow area, round in outline and about 3 centimeters in diameter. The color was sulphur yellow (?). The upper half of the tumor was of a very dark color extremely friable. Small nodules were seen in the renal parenchyma or what was left of it.

Microscopic examination showed huge compact epithelial cells in nests containing new sharply defined tubules, both large and small similar tubules out in the fibrous stroma were abundant, elsewhere they were only few in number. Central agglutination of cells in the epithelial cell masses forming new tubules. Single strands of striated and non striated muscle throughout the loose stroma. Dense strands of fibrous tissue. Diffuse focal compression atrophy with necrosis and masses of disintegrated leucocytes.

CASE 17 J. L., male, white, aged 16 months, was admitted to the Presbyterian Hospital on the service of Dr. A. H. Parmelee, December 14, 1927. Two weeks before admission to the hospital the parents noticed a mass in the upper left side of the abdomen. The mass was painful when handled and grew rapidly since it was first noticed. The child was restless and did not sleep well at night and there was a slight rise in temperature. There were no urinary symptoms. Physical examination disclosed a well nourished child who did not appear acutely ill. The head, neck, heart and lungs were negative. A large palpable mass was noticed in the upper left quadrant which seemed to be connected with the left kidney. Upon palpation the mass was tender. The temperature was 99.7 degrees on admission. Blood examination disclosed red blood cells, 4,300,000; white blood cells, 10,050; haemoglobin 65 per cent. The Von Pirquet was negative. Urinalysis showed reaction, acid, albumin 0, sugar 0, sediment, occasional white blood cell, blood, 0, few red blood cells. Fluoroscopic examination (barium meal) showed displacement of the colon by a mass in the left upper quadrant. Roentgen ray examination of chest was negative except that the diaphragm was slightly elevated, probably pushed upward by the tumor, of the abdomen showed the transverse and splenic flexure pushed down by mass filling almost the entire left upper quadrant.

Operation (Dr. E. M. M.) December 16, 1927 (ether anesthesia). Incision for exploratory lapa-

rotomy was made. A malignant tumor of the left kidney, the size of a large grapefruit presented between the spleen and transverse colon extending 2½ inches to the right of the midline and as far to the left as one could feel, it was fixed posteriorly. No attempt was made to remove the tumor. A small piece of tissue was removed for histological study. Closure was made in the usual way.

The postoperative course was uneventful. Child was discharged from the hospital December 27, 1927, and died June 21, 1928.

Microscopic examination showed huge epithelial cell masses containing new tubules which were only poorly defined, many of them suggestive of tubule formation because of central clumping of cells. Epithelial cell nuclei were large, pale stained, and contained finely granular chromatin, diffuse fibrous tissue hyperplasia. Isolated strands of non striated muscle and indistinct striated muscle fibers stained with phosphotungstic acid hematoxylin.

PATHOGENESIS

Distinct forms of mixed tumors of the kidney in children were first described in 1884, by Jacobi, although in 1872, Eberth described tumors of the kidney which contained more than one type of tissue, among which were muscle elements. Eberth believed that such tumors were the result of inclusions in the kidney of parts of the wolffian body. To Birch Hirschfeld, however, belongs the credit of recognizing that these tumors have histological features common to neoplasms, and contain a mixture of epithelial and connective tissue elements which proliferate in a most extensive embryonal manner. Birch Hirschfeld agreed with Eberth, that these tumors have their origin in remnants of the wolffian body. He says that the glandular tissue is primary and interprets the round cells as transition forms which may at any time differentiate into glandular structures.

In 1899, Wilms, whose name is often attached to these tumors, published a monograph which cleared up much of the confusion which existed regarding their origin. Wilms' explanation of the origin of the tumors has been generally accepted. He showed that mixed tumors of the kidney were composed of a variety of different tissues, that all the tissues developed from a cell tissue which did not show any of the known differentiating marks. Glandular elements were always present, smooth and striated muscle, cartilage,

fat, elastic, fibrous, and myxomatous tissue were nearly always present. Wilms disputed Birch-Hirschfeld's views for he said that although the wolffian body does contain non-striated muscle fibers, it does not contain any striated muscle fibers which are so often present in these tumors. He assumed that these tumors arose from a scattered displacement of undifferentiated mesodermic germinal tissue which later gives rise, in the course of normal development, to the pronephros and wolffian body and to the myotomes. This undifferentiated cell tissue must, therefore, have the potential quality of being able to produce all the different types of tissue, even though with our present limited status of the knowledge of cells, this may appear too extraordinary to be plausible. In other words, the cell tissue must be an embryonal germinal variety that is still in the first stages of development.

The primary segment or myotome furnishes the entire striated musculature of the region of the neck. This myotome also furnishes the musculature for the trunk and extremities. Granting that the entire transversely striated musculature is derived from the myotome, it is evident also that transversely striated muscle fibers occurring separate from the normal muscle fibers, as in the renal tumors, must be traced back to misplaced portions of the myotome.

The smooth muscle fibers arise from the mesenchyme. Wilms states that the smooth muscle fibers have as little relation to the transversely striated ones, that is in their origin, as does adipose or cartilaginous tissue.

The possibility of development of bone is, of course, not always present, and in rare cases bone has also been found. As a rule the external conditions of bone growth necessary for the bone are absent.

Wilms believes that the glandular elements found in these tumors take their origin from the wolffian body. He is also of the opinion that they are not misplaced, in primary fashion, in the form of developed glands, but become differentiated gradually from the embryonal round cell tissue. This round cell tissue lying in alveoli has been misplaced from the wolffian body and from the round cell, and, in secondary fashion, the glandular formation



Fig 8 The embryonic tubules which are a conspicuous feature of these tumors are sharply defined and usually present within the circumscribed masses of undifferentiated cells with dense nuclear chromatin and many mitoses. These masses of cells have been called 'epithelial cell nests' ($\times 200$)

develops. This undifferentiated embryonal tissue, when it proliferates, may thus produce the tubules that simulate those in the wolffian body, it may produce the embryonal muscle cells so often present in these growths, and if a portion of the sclerotome is carried along, cartilage also may be found. These tumors contain a mixture of tissue, any of which may predominate.

Herzog, a year later, claimed that inasmuch as tumor growth in general is regressive rather than progressive, it is not logical to assume that undifferentiated round cells later on become epithelia, first aggregated in irregular masses, then giving rise to regular tubular glands. He suggested that if the nephrotome is not cut off at the normal site, an inclusion of a portion of either the myotome, sclerotome, or both might result. Thus a matrix containing all those embryonic elements which occur in mixed renal tumors might be formed.

There has been no essential contribution to these theories since that time.



Fig 9 Undifferentiated cells in diffuse masses without embryonic tubules are often present. These cells differ from those in the epithelial cell nests in that they are more polyhedral, have fewer mitoses, and less nuclear chromatin ($\times 480$)

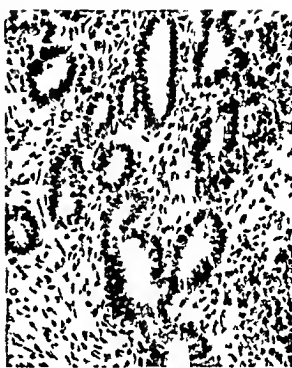


Fig 10 The tubules often occur in the loose stroma outside of the undifferentiated cell masses and are usually sharply defined ($\times 325$)

GROSS PATHOLOGY

Embryonal adenosarcoma of the kidney is the most common tumor of the kidney in swine, in fact, it is the most common tumor in swine. This was first observed by Day in 1899, who in 1907 demonstrated the similarity between these tumors in man and in swine. Young pigs usually are affected. The growth begins in one pole of the kidney, and destroys the kidney by pressure atrophy. Both kidneys are frequently affected, but metastases rarely occur. In one instance a tumor weighing 60 pounds was studied by Day.

The tumors in swine differ from those in the human (Fig 18) in that the tubules are more abundant, more sharply defined, and many of them are folded into a papilla like structure. Smooth muscle is abundantly present, but striated muscle has not been found. Bone and cartilage are usually present in the swine tumors but seldom in the human. These tumors have never been described in cattle or sheep.

Embryonal tumors of the kidney are the most common primary neoplasms which occur in children. The tumors, which are occasionally bilateral, have been described as of such size at birth as to cause dystocia. The largest of our tumors weighs 1,530 grams, the smallest, 235 grams, and the average weight of all of our tumors is 762 grams. The tumors are predominately unilateral, only 2 of the 17 are bilateral. They are encapsulated, retroperitoneal, and arise within the kidney capsule. The involved kidney usually occupies the entire side of the abdomen and displaces viscera in direct proportion to the size of the tumor. They are globular to oval shape, solid, opaque, and variously subdivided into lobules. Somewhere on the surface a nodule of kidney tissue usually remains. This kidney tissue is normal in all essentials except where it is adjacent to the tumor, where it is compressed and thins out to cover the neoplasm nearby usually for several centimeters, so that at its peripheries it may be only a millimeter thick.



Fig. 11. Cross striated muscle fibers when present usually occur in clumps throughout the stroma and occasionally in definite bundles ($\times 750$)



Fig. 12. Higher magnification of same section as shown in Figure 4

These tumors arise within the kidney itself, they may occur in any portion of it, and compress the kidney so that it undergoes pressure atrophy. The kidney takes no part in the tumor formation, so that a layer of fibrous tissue free of renal structures separates the tumor from what remains of the compression atrophied kidney. The kidney and its adherent neoplasm are intimately fused together and cannot be separated from each other without extensive laceration, except for that peripheral nodule of kidney not as yet compressed.

The degree of kidney change in size and shape varies with the size of the tumor. A portion of kidney tissue about one-half the size of its opposite kidney is the largest amount of kidney substance remaining adherent to the tumor fused with the neoplasm in any of our patients. The amount of kidney tissue remaining varies from a portion of a pole of the kidney downward to a band of kidney tissue 1 to 2 millimeters thick where it covers the neoplasm. The surface consists of the capsule raised irregularly by rounded nodulations. The nodules vary from pea size to the size of an

adult's clinched fist. The new-growth generally is firm and retains its shape when placed on a hard surface. They are gray to pink outside and only delicately vascular.

The surfaces made by sectioning are uniformly firm, fibrillar, lobulated, and gray to faint pink yellow in split-pea size places. Lobules are from 2 to 6 centimeters in general diameter. They are separated from each other by fibrous bands. Most of the lobules are firm throughout except for isolated portions which are soft, friable, with the consistency of an infant's brain. Elsewhere they are pink to dark red in places and 4 to 6 centimeters across. These portions are soft, porous to sponge-like with compressible resistance, and moist. Although this portion is fused intimately with the gray tumor tissue it is in sharp contrast to the major portions which are gray. The soft, fluid-like places are those of compression atrophy and liquefaction necrosis.

MICROSCOPIC PATHOLOGY

The embryonal structure of these tumors is their most distinguishing feature with a variety



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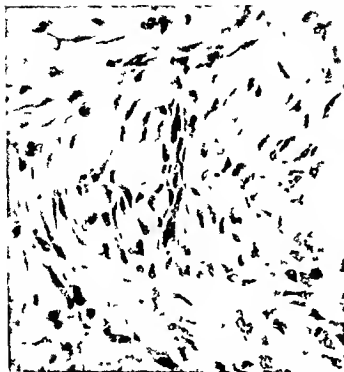


Fig. 15 A loose, spindle cell stroma is always present in some portion of these tumors ($\times 480$)

the epithelial cell masses. Non-striated fibers are present in all of these tumors and are usually present in compact clumps in an orderly arrangement.

Aberrant cross-striated muscle fibers have also been observed in the thyroid gland (Hirsch), and in the sino-auricular node (Vater).

Necrosis of the tumor itself is often marked. It usually is most marked where growth has been most rapid.

In the portion of the kidney not yet obliterated, where the kidney is adjacent to the tumor, the tubules are usually widely dilated.

The recurrences of tumor growths following surgical excision of the primary tumor have all been histologically similar to the original tumor structure.

Cartilage or bone was not found in any of our tumors.

METASTASES

Extensions and metastases of these tumors are exceptional unless the original tumor is large. Regional involvement by extension is the usual method of growth. Extension metastases may occur throughout the entire abdomen, engulfing the viscera by its growth so as completely to enclose such viscera as the



Fig. 16 Metastases in the liver. When present in the liver the metastases simulate the structure of the original tumor ($\times 290$)

pancreas and suprarenals. They may penetrate through the walls of the blood vessels, usually the veins, in one instance a ureter, and may extend through the diaphragm so that tumor nodules may be present on its pleural surface. Haematogenous extensions are predominately to the liver and occasionally to the lung. Metastases in the liver (Fig. 16) duplicate remarkably the typical new tubule formation, which tubules may be present in clumps or single tubules in a matrix identical to that of the primary tumor. Muscle fibers were not seen in the metastases. Metastases in the lungs (Fig. 17) are usually nodules 1 to 3 centimeters in diameter. They are firm, gray, and sharply-defined. These consist of undifferentiated round cells with scant chromatin.

In isolated places they retain a mass of polymorphous cells, with dense chromatin, arranged in a compact cluster, and they resemble abortive renal tubules. These extension metastases may be so huge as to compress great veins or by compression in the liver, bile cysts may result.

SEX

As a rule the question of sex is of but little moment as an aid in making a diagnosis, so that the sex incidence is only one of academic interest. Still it is extremely interesting to note that in this series of 17 cases, 14 of them occurred in males whereas only 3 were females.



Fig 13 Cross striated muscle fibers may also occur within the masses of undifferentiated cells adjacent to tubules (X390)

of tissue of abortive renal elements. The types of cells and amount vary in the different tumors. They are usually myxomatous tissue composed of masses of polymorphous nucleated cells in which are imbedded gland or duct like figures resembling uriniferous tubules which may be sparse or abundant. These embryonic tubules in a heterogeneous matrix are the most conspicuous features. There are both epithelial and connective tissue elements. The epithelial elements consist of small and large undifferentiated cells which are often spoken of as epithelial cell nests and embryonal tubules. The connective tissue elements consist of loose stroma, undifferentiated round cells, striated and non striated muscle fibers. These elements are most irregularly mixed. The tubules are in many stages of development and usually consist of single layers of cuboid and columnar type epithelium, although several layers are occasionally present resting on a thin basement membrane. The tubules, in general, are round, but occasionally have horseshoe shaped lumina which may be irregu-

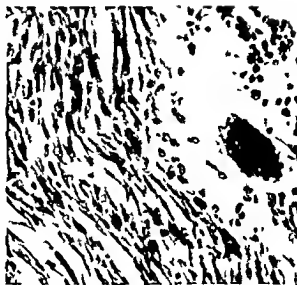


Fig 14 Non striated muscle is usually present in these tumors and occurs chiefly in compact masses (X450)

lar in outline. The tubules may occur in dense lobular clumps separated by only a few cells or they may be present as a single tubule in solid masses of undifferentiated cells which divide rapidly. The lumen of the tubule occasionally may not be visible and other tubules in the process of growth may be indicated by a clumping of the cells in the central portions of the masses of undifferentiated cells. The chief features of these cells are their polymorphism, abundance of mitotic figures, and dense chromatin. They may have fragmented nuclei, and but little cytoplasm. The stroma between the masses of embryonal cells is myxomatous and delicately fibrous. The epithelial cell nests which stain deeply, are often sharply defined from other undifferentiated masses of cells which are more round, contain less chromatin and fewer mitoses. The fibrous bands which group the tumor cells in rather large clusters contain, in places, cells with spindle shape nuclei which are usually sparsely distributed.

Striated muscle is another interesting feature of these tumors. These fibers are best stained with phosphotungstic acid hematoxylin. Striated muscle is present in the majority of these tumors. It is present usually in clumps of fibers, but occasionally single strands of striated muscle ramify throughout

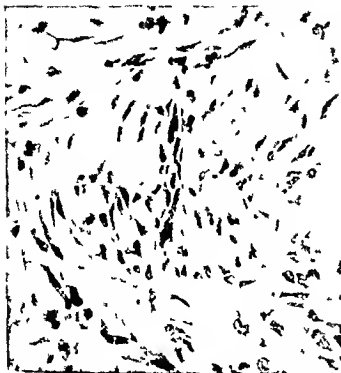


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Extensions and metastases of these tumors are exceptional unless the original tumor is large. Regional involvement by extension is the usual method of growth. Extension metastases may occur throughout the entire abdomen, engulfing the viscera by its growth so as completely to enclose such viscera as the



Fig 16 Metastases in the liver. When present in the liver the metastases simulate the structure of the original tumor ($\times 290$)

pancreas and suprarenals. They may penetrate through the walls of the blood vessels, usually the veins, in one instance a ureter, and may extend through the diaphragm so that tumor nodules may be present on its pleural surface. Hematogenous extensions are predominately to the liver and occasionally to the lung. Metastases in the liver (Fig 16) duplicate remarkably the typical new tubule formation, which tubules may be present in clumps or single tubules in a matrix identical to that of the primary tumor. Muscle fibers were not seen in the metastases. Metastases in the lungs (Fig 17) are usually nodules 1 to 3 centimeters in diameter. They are firm, gray, and sharply-defined. These consist of undifferentiated round cells with scant chromatin.

In isolated places they retain a mass of polymorphous cells, with dense chromatin, arranged in a compact cluster, and they resemble abortive renal tubules. These extension metastases may be so huge as to compress great veins or by compression in the liver, bile cysts may result.

SEX

As a rule the question of sex is of but little moment as an aid in making a diagnosis, so that the sex incidence is only one of academic interest. Still it is extremely interesting to note that in this series of 17 cases, 14 of them occurred in males whereas only 3 were females.



Fig 17 Metastases in the lung. When present in the lungs the metastases consist essentially of undifferentiated cell masses with less nuclear chromatin than the cells in the primary tumor. The tubules are seldom sharply defined and are usually indicated by a clump of cells in a gland like arrangement ($\times 480$)

AGE

The oldest case in this series was 6 $\frac{1}{2}$ years and the youngest, 3 months

| | Cases |
|--------------------|-------|
| Under 6 months | 2 |
| 6 months to 1 year | 1 |
| 1 to 2 years | 5 |
| 2 to 3 years | 3 |
| 3 to 4 years | 1 |
| 4 to 5 years | 0 |
| 5 to 6 years | 3 |
| 6 to 7 years | 2 |

ONSET

As a rule the time that had elapsed between the time when the symptoms were first noted and when the parents took the little patients to the doctor for examination was very short. This varied from 6 days in one case to 12 months in the longest. It was exceedingly hard to get an accurate line on the time of onset, i.e., to determine the length of time that the tumor had been present, because so many of these little patients when brought in had been ill or demonstrated symptoms for only a relatively short period of time, whereas examination revealed very large, extensive abdominal tumors so that it was quite evident that the growth had reached its large size before its presence was discovered and the patients sent in.



Fig 18 Embryonal adenocarcinoma of the kidney in swine. In these tumors of swine the conspicuous feature is the abundance of tubular structures of various shapes and sizes. The tubules in swine tumors are evidently more mature than in the human. Striated muscle is seldom present, but non striated muscle, cartilage, and bone are commonly found ($\times 325$)

PAIN

In 5 cases the patients complained of pain in the region of the tumor. In Case 7 the tumor was located on the right side and the pain complained of was on the left side.

URINARY SYMPTOMS

Frequency of urination was present in only 1 case (Case 1). This symptom however, was not very severe but had been present for 4 months.

Hæmaturia. Gross blood in the urine was not found. In one case (Case 2) the patient's history at the time of admission was negative on this point and the mother was told to look for blood in the urine. On patient's second admission the mother said that since leaving the hospital there had been some bloody urine, but this was *not verified*. It would seem, therefore, from a study of this series of cases, that the statement is justified that hæmaturia—gross bleeding—is rarely present in this type of tumor. Our own experience coincides with this view.

FEVER

An increase of temperature is often found in malignant tumors of the adult. Israel drew attention to this fact many years ago. An analysis of malignant tumors in the adult by one of us (H. L. K.) showed an elevation of temperature in 11 in a series of 54 cases. But attention was drawn at that time to the fact that other conditions were present that might have been factors in the production of fever such as infections in the teeth, tonsils, and sinuses.

In this group of 17 cases, fever was present in 9 cases.

GENERAL SYMPTOMS

| | Cases |
|------------------------|-------|
| Palpable tumor | 17 |
| Fever | 9 |
| Pain in abdomen | 6 |
| Loss of appetite | 4 |
| Loss of weight | 3 |
| Constipation | 3 |
| Irritability | 2 |
| Vomiting | 2 |
| Frequency of urination | 1 |

SIDE INVOLVED

Equally interesting was the fact that although it is generally assumed that right sided kidney lesions are more common than left sided lesions, we find quite the reverse situation in our studies, in that in 10 of the 17 cases the malignant tumor was found on the left side and in 5 on the right. In 2 cases (Cases 4 and 12), there was a bilateral involvement, an exceedingly rare finding as far as we can tell, judging from case reports in the literature (Fig. 7, Case 12). Whether this was due to a primary tumor developing in the remaining kidney after the decapsulation or whether the growth was metastatic is a question which we feel we cannot positively answer.

| | Cases |
|-----------|-------|
| Left | 10 |
| Right | 5 |
| Bilateral | 2 |

PRESENCE OF TUMOR

In every one of these cases a palpable tumor was present. In all but one, the presence of the tumor was directly responsible for the patients being brought to the physician. As a rule, the tumor was discovered accidentally

either by the mother or a nursemaid, and therefore was the first symptom. Furthermore, a careful review of these cases showed that the presence of tumor was about the only symptom of which they complained. In only 3 of these patients was there a direct history of trauma (Cases 11, 14, and 16).

URINALYSIS

Albumin was present in 7 cases, microscopic blood was found in only 1 case. In 1 case the presence of sugar was noted. When this patient entered the hospital the urine was negative. Re-entering on account of extensive abdominal metastases, particularly in the region of the liver, an examination of the urine revealed the presence of sugar. The metastatic masses involved the liver. In 3 cases a few red blood cells were found in the urinary sediment.

| | Cases |
|-------------------|-------|
| Albumin | 7 |
| Leucocytes | 5 |
| Red blood cells | 3 |
| Casts | 2 |
| Microscopic blood | 1 |
| Sugar | 1 |

The Wassermann test was negative in all cases.

BLOOD COUNTS

In every case there was present a very definite evidence of a secondary anemia. This was most marked in Case 2, in which the red count was 2,000,000. There was an increase in the white blood cells in 8 cases. The highest count was 28,650.

CYSTOSCOPY AND URETERAL CATHETERIZATION

The problems of diagnosis and the study of renal function in these cases do not differ from those in the adult. All these cases should be subjected to cystoscopic examination and ureteral catheterization for purposes of making a pyelogram and in order to determine the function of the opposite kidney. An intravenous pyelogram may be made before the cystoscopic examination is carried out and, if necessary, this can be checked with pyelograms from below.

The cystoscopic examination when done was negative.



Fig. 17 Metastases in the lung. When present in the lungs the metastases consist essentially of undifferentiated cell masses with less nuclear chromatin than the cells in the primary tumor. The tubules are seldom sharply defined and are usually indicated by a clump of cells in a gland like arrangement ($\times 480$)

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| | 2 |

ONSET

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The cystoscopic examination when done was negative

In one case the pyelogram was practically normal outside of showing a few minor changes in the calyces due to clubbing, but there was no compression and filling defect such as one generally sees in malignant tumors.

Because the tumors were large and completely filled the kidney pelvis, many of the cases showed so complete a blocking at the uteropelvic junction, that no pyelogram could be obtained.

This type of finding may at times be confused with a block at the ureteropelvic junction due to a large hydronephrosis associated with kink and thereby preventing a filling of the kidney pelvis. In one of our cases, in which the tumor was rather soft and elicited a feeling of slight fluctuation, the possibility of hydronephrosis was considered.

The pyelogram is not only of value in differentiating various types of kidney lesions but it is also valuable in differentiating lesions of the liver and spleen as well as those rare cases of tumors of the adrenal, hydronephrosis, solitary cyst of the kidney, and congenital polycystic disease, although solitary cyst of the kidney and congenital polycystic disease rarely call for differentiation in early life. Finally, the importance of determining the presence of a second kidney and of estimating its function before nephrectomy is just as important in children as it is in adults. A point that should be stressed is the possibility of bilateral involvement, inasmuch as we found this complication in 2 of 17 cases, that is, nearly 12 per cent.

SUMMARY

1 A series of 17 cases of this supposedly rare and unusual type of kidney tumor is reported.

2 Some of the cases were incorrectly diagnosed and a subsequent study by us revealed the true nature of the tumor.

3 This type of tumor is the most common tumor found in swine.

4 A careful histological study of specimens is convincing that this growth is the common tumor of infancy and childhood.

5 Hematuria, so common in the adult, is rarely, if ever, present in children.

6 Most of the patients are seen when the tumors have reached an enormous size.

7 The prognosis is bad, 16 of our 17 patients died.

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THE INFLUENCE OF CERVICAL PARAVERTEBRAL ANÆSTHESIA UPON THE PULSE RATE DURING OPERATIONS UPON THE TOXIC THYROID GLAND¹

ALFRED BROWN, M.D. I A C S, OMAHA, NEBRASKA

From the Department of Surgery, University of Nebraska College of Medicine

OF late years the use of iodine in the pre-operative preparation of patients suffering from toxic goiter has done much to rid the mind of the surgeon of fear of cardiac collapse during operation and the danger of the so-called thyroid crisis following operation. In operations performed under local infiltration anesthesia or one or other of the various inhalation anesthetics, the pulse becomes more rapid during operation and the necessary manipulations of the operative procedure place an added strain upon the already overstimulated cardiac mechanism which may result in a more or less stormy postoperative convalescence even though cardiac collapse does not occur. A form of anesthesia, therefore, which will control this cardiac hyperexcitability even temporarily should be of benefit, and to demonstrate that cervical paravertebral anesthesia appears to accomplish this end will be the object of this paper.

THE CARDIAC ACCELERATOR MECHANISM

The impulses which control the rate of the heartbeat reach the heart from without through the sympathetic and parasympathetic nervous systems—the sympathetic conveying the accelerator and the parasympathetic the depressor impulses. The fibers of the sympathetic system through which these accelerator impulses are conveyed arise at various levels from that portion of the sympathetic ganglionated cord which extends from the superior cervical to the fourth thoracic ganglion and may, for the purpose of this discussion, be divided into three main groups, an upper, middle, and lower. The upper group is formed by the superior and middle cervical cardiac branches of the sympathetic and is the group with which we are principally concerned. The middle group includes the lower cervical cardiac nerve which arises from the lower cervical ganglion and the lower group takes in the upper thoracic cardiac nerves

which have lately been described by Kuntz and Morehouse (Figs. 1 and 2).

The superior cervical cardiac nerve arises from the lower portion of the superior cervical ganglion or the sympathetic cord immediately below it and passes downward on either side of the neck lying on the surface of the longus colli muscle. On the right side the nerve ultimately reaches the deep cardiac plexus and on the left, after crossing over the arch of the aorta behind the innominate artery joins the superficial cardiac plexus (Figs. 1, 3, and 4).

The middle cervical cardiac nerve is a variable quantity. In some cases it is absent on one side or both and in this event its function is taken over by the superior cardiac nerve. When present it may arise from the middle cervical ganglion or, if this is absent, from either the sympathetic cord immediately below the superior cervical ganglion or from the superior cervical ganglion itself (Figs. 1, 3, and 4). In any event the nerve of each side enters the deep cardiac plexus as it passes over it.

It can thus be seen that a considerable amount of the cardiac accelerator stimulation is carried by nerves which have their origin in the upper portion of the neck in close proximity to the points of emergence of the four upper peripheral cervical nerves and to the transverse processes of the four upper cervical vertebrae. Consequently, the injection of an anæsthetic solution around these nerves or around their points of origin from the superior cervical sympathetic ganglion and upper part of the sympathetic cord should theoretically anesthetize them temporarily and result in the cutting off of a greater or lesser amount of the accelerator impulses reaching the cardiac plexuses. A considerable portion of the hyperexcitability of the sympathetic system due to the altered thyroid secretion thus being cut down or abolished, the moderator influence of the parasympathetic

¹ Read before the Western Surgical Association, Kansas City, Missouri, December 5-6, 1930.

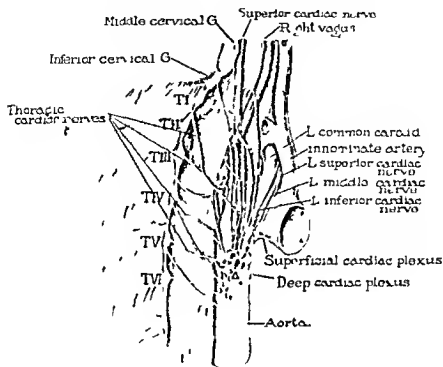


Fig. 1. The nerves entering the cardiac plexus from the right side (After Kuntz and Morehouse)

should be able to counterbalance, at least in part the accelerator impulses reaching the heart from the lower cervical and upper thoracic sympathetic nerves and a slowing of the pulse rate result.

THE FASCIAL RELATIONS OF THE UPPER CERVICAL SYMPATHETIC GANGLION AND SYMPATHETIC CORD

The upper cervical sympathetic ganglion appears to be very closely related to many extremely important structures in the neck, anesthetization of which would be very dangerous. The most important of these structures is the pneumogastric nerve. The ganglion is situated behind the carotid vessels and the internal jugular vein and is crossed obliquely by the pneumogastric nerve (Fig. 4). These structures are however, enclosed in the carotid sheath and posterior to this there is a layer of connective tissue, the sympathetic sheath, which covers the surface of the upper ganglion and cord and still further separates it from the structures in front of it (Figs. 5 and 6). This sheath is present in front and

lateral to the ganglion as well as behind it and at its anteromesial and posterolateral portions blends with the fascial layers of the prevertebral muscles and deep muscles of the neck. Enclosed within this sheath is a mass of loose areolar tissue in which are situated the superior ganglion and its branches. The upper cervical nerves as they go to their definitive points of distribution, pass through this tissue, and it is in this tissue that the anesthetic is placed in paravertebral anesthesia. The main branches of the ganglion which are of interest in this situation are the rami communicantes between it and the upper cervical nerves (Figs. 3, 4 and 7). These branches, if temporarily divided as it were, through paralysis by a local anesthetic should serve to isolate the superior ganglion still further from the structures with which it is connected, and render it still more impossible for it to exert its accelerator function on the cardiac beat. In other words the injection of an anesthetic solution into the loose connective tissue lying in front of and lateral to, the transverse processes of the upper four cervical vertebrae

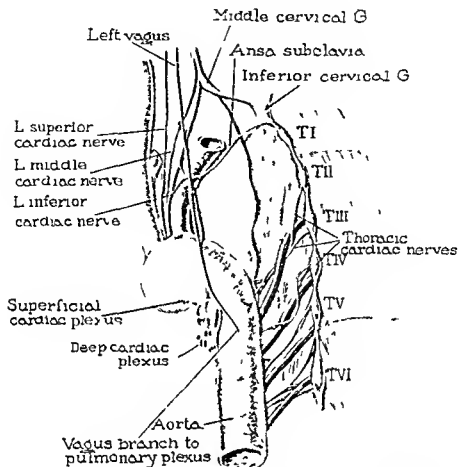


Fig 2 The nerves entering the cardiac plexus from the left side (After Kuntz and Morehouse)

should result in what to all intents and purposes would be a temporary resection of the upper cervical sympathetic ganglion and the upper portion of the cervical sympathetic cord together with the superior and a great portion of the middle cervical cardiac nerves.

The procedure of sectioning the sympathetic cord below the superior cervical ganglion to prevent ulceration of the cornea in exophthalmic goiter was suggested and performed by Edmunds in 1895. In the following year Jaboulay repeated the procedure believing that it would benefit the symptoms of exophthalmic goiter. Jonnesco, who first reported on the subject in 1896, at first resected the upper sympathetic ganglion and later extended the procedure to the entire cervical cord including the middle and inferior ganglia for the relief of symptoms of toxic goiter. These men and others later reported amelioration and in some instances symptomatic cure of toxic goiter patients by these procedures.

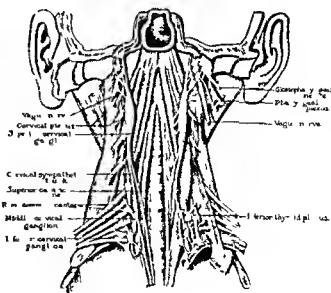


Fig 3 Cervical sympathetic system showing the ganglia, the connections with the peripheral nerves and its peripheral branches (After Toldt)

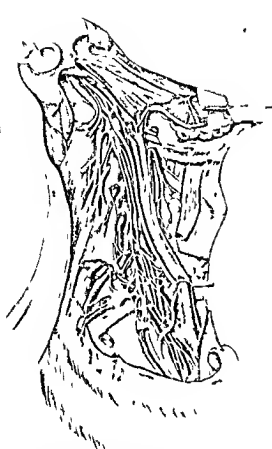


Fig 4 The sympathetic nervous system of the right side of the neck showing the superior and middle cardiac branches of the sympathetic and the connection of the upper cervical sympathetic ganglion with the peripheral nerves (After Jonnesco)

It is therefore evident that a method of anæsthesia which would temporarily inhibit the increased action of the accelerator portion of the sympathetic system should show, as a result of this action, a diminution in the frequency of the pulse while the anæsthetic is active and with this, less shock resulting from the operation and less reaction following it

In order to determine the behavior of the pulse as to its frequency during operation on toxic goiter, a record of the beat was taken every 5 minutes either from the time the patient entered the operating room or from the time the actual operation was begun and continued until the close of the operation. Subsequently the rate of the pulse was recorded graphically (Fig 8)

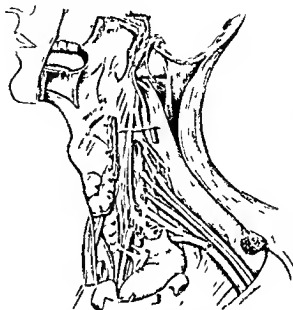


Fig 5 The sympathetic system of the left side of the neck. Note particularly the fascia covering the upper cervical ganglion and its branches and separating it from the carotid vessels (After Jonnesco). It is beneath this fascia that the anæsthetic is deposited

Although it was my impression that during operations under infiltration anæsthesia there was a tendency for the pulse rate to rise either throughout the operation or reach its peak at the time of actual division and removal of the anterior portions of the thyroid from that portion of the gland to be left on either side, two operations were performed under infiltration anæsthesia, the patient being prepared exactly as for paravertebral anæsthesia and the pulse rate recorded and subsequently graphs made. These showed as was expected practically a continuous rise in pulse rate throughout the early and difficult portions of the operation (Fig 8 A and B)

Observations were then made on a series of 18 cases of goiter exhibiting toxic symptoms of varying degrees of severity which were operated upon under cervical paravertebral anæsthesia. The cases represented a varying symptomatology so far as the presence of eye signs and tachycardia were concerned as well as the duration of symptoms

The graphs obtained (Fig 8 C to T) appear to fall into two main divisions (Fig 8 C to P

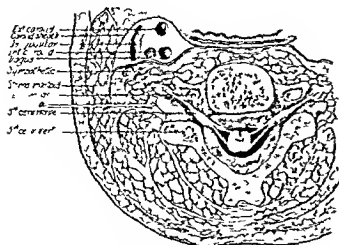


Fig 6 Cervical plexus block by the lateral route. Cross section of neck at level of third cervical vertebra showing direction of needle, a. Note the comparatively thin layer traversed by the needle and the distance of the large blood vessels from the path of the needle and site of injection and their protection by the carotid sheath. Note also the position of the sympathetic cord and its relation to the third cervical nerve. (Modified from Labat.)

and Q to S), with a graph (Fig 8 T) which seems difficult to interpret.

In the first group (Fig 8 C to P) is represented a series of cases of goiter showing symptoms indicative of varying degrees of hyperthyroidism. Some were acute cases and other cases of long standing. Some showed definite exophthalmos, others did not. One case had passed through two attacks of auricular fibrillation one of which had been preceded by an attack of auricular flutter. There were different changes in the percentage of free hydrochloric acid in the stomach contents varying from practically normal to absence of free hydrochloric acid. The essential point, however, is that all showed symptoms of hyperthyroidism of some type. The postoperative examination of the glands removed at operation showed histological changes varying from almost pure adenoma to practically pure hyperplasia.

The pulse graphs exhibit a remarkable similarity. There is a rapid rise in pulse rate during the administration of the paravertebral anæsthesia comparable to the rise in pulse rate shown in the cases operated upon under infiltration anæsthesia. During this period the patient is disturbed by the turning of the head, introduction of the anæsthetic, and finally by being draped for the operation. By the time draping is completed the patient is



Fig 7 The sympathetic system in the neck showing the connections of the upper cervical sympathetic ganglion with the peripheral nerves. (After Spalteholz.) Note the close relation of the ganglion to the transverse processes of the cervical vertebrae.

anæsthetized and with the beginning of the operation the pulse begins to fall in frequency and on the average reaches its lowest rate at the time the thyroid gland is being delivered, divided, and removed. If the operation is performed slowly there is a slight rise in pulse rate which occurs on an average of 35 or 40 minutes after the start of the operation which I interpret as being due to the beginning recovery of the sympathetic ganglion and cord from the effects of the anæsthesia and the renewal of the transmission of accelerator impulses to the heart. After the return of the patient from the operating room the pulse rises, but the postoperative rise in pulse rate is less high, and the convalescence smoother, than in cases operated upon by other methods of anæsthetization.

The second group of graphs (Fig 8 Q to S) is taken from cases exhibiting cardiac irregularity or auricular fibrillation at the time of operation. These graphs are, with our present knowledge, practically impossible to interpret.

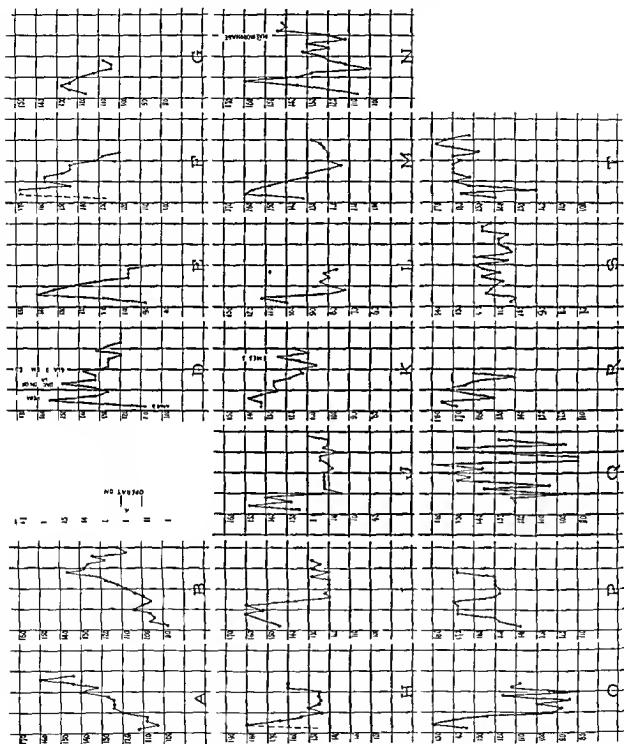


Fig 8 Graphs of the pulse rate during operations for toxic goiter. The distance between dots represents a time interval of 5 minutes. The figures at the left represent the frequency of the pulse.

It is my belief that the apparent rise in rate is due to the fact that more beats are coming through to the wrist and that though the pulse is actually more rapid, the heart action is in reality of better quality, but at present there is no evidence that this is the true conclusion and further investigation of similar cases will be necessary before this hypothesis can be either proved or disproved.

Graph T, Figure 8, is an extremely interesting one as it differs from any of the other graphs obtained. It will be noted that the sharp rise in rate during the administration of the anæsthetic corresponds to the rise seen in graphs C to P. This is followed by the rapid fall in rate characteristic of these same graphs, but this is followed by an immediate rise to a high rate which is maintained throughout the remainder of the operation. Gastro intestinal symptoms in this case were more marked than in any of the other cases, which would point to a condition of hyperexcitability of the sympathetic chain below the area of anæsthetization. This hyperexcitability acting through the lower cervical and upper thoracic sympathetic nerves to the cardiac plexuses might be sufficient to maintain the pulse at a high level as they would not be anæsthetized. The primary drop of short duration may be explained by an evanescent preponderance of the parasympathetic when part of the sympathetic hyperexcitability was suddenly removed by the anæsthetization of the superior and middle sympathetic cardiac nerves.

CONCLUSIONS

1 Cervical paravertebral anæsthesia, in addition to anæsthetizing the upper cervical nerves also anæsthetizes the upper cervical sympathetic ganglion and the upper part of the sympathetic cord.

2 This anæsthetization renders the superior and middle cervical cardiac nerves incapable of transmitting to the heart the increased accelerator impulses caused by the hypersensitization of these nerves and the moderator impulses of the vagus reach the heart opposed only by the accelerator impulses through the lower cervical and upper thoracic cardiac branches of the sympathetic which are usually not strong enough to overcome the vagus action completely and the pulse rate falls. Consequently—

3 During the operation of subtotal thyroidectomy for hyperthyroidism, cervical paravertebral anæsthesia exerts a definite action toward slowing the rate of the pulse.

4 Owing to the fact that under paravertebral anæsthesia cardiac shock is less marked, the operative procedure does not diminish the patient's already weakened cardiac reserve and the postoperative course is smoother with relatively less cardiac reaction than with other types of anæsthesia.

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AN HISTOLOGICAL STUDY OF THE PERIVAGINAL FASCIA IN A NULLIPARA¹

BYRON H GOFF MD FACS NEW YORK

Attending Surgeon Woman's Hospital in the State of New York

THOUGH much thereon has been written, gynecologists still differ widely in their opinions about the pelvic fascia, especially about that portion of it which surrounds the vagina. Some contend that there is a layer of fascia between the wall of the vagina and the walls of the urethra, bladder, and rectum. They believe that obstetric injury to this fascia is the fundamental cause of cystocele, rectocele and urethrocele. Furthermore, when operating for these conditions they demonstrate by dissection a layer of palid tissue several millimeters thick, which lies just beneath the vaginal mucosa, and term it fascia. On the contrary, others deny the existence of such a fascia. They offer various explanations concerning the cause of the conditions mentioned and contend that successful vaginal plastic surgery is not essentially based on the utilization of fascia.

In view of the fact that there is such a wide difference of opinion and since the prevalent opinions are based on the findings in gross dissections or on microscopic studies of material from abnormal subjects it has seemed logical to resort to an histological cross section study of the tissues in and between the walls of the vagina, bladder, urethra, and rectum in a normal nullipara, for only by means of such studies will it be possible to establish important fundamental facts concerning their character and interrelationship under normal conditions. It is obvious that an accurate knowledge of the normal structure of the tissues in and about the vaginal wall is essential to a clear understanding of the etiology and surgical treatment of cystocele, rectocele, and urethrocele. A careful search through the literature has failed to reveal any previous attempt of a similar nature with the exception of a study by Spaulding of sections from the vesicovaginal septum in which the author has failed to state whether the subject from whom the material was taken was nulliparous or multiparous.

Before entering into a discussion of any part of the pelvic fascia, it is important to agree upon a definition of the term fascia which will be acceptable to histologists. Obvious as this may seem, it is all the more important since many gynecologists are inclined to include under the term fascia tissue which has the gross appearance of fascia but which histologically is composed principally of smooth muscle with a relatively small amount of interfascicular connective tissue. A perusal of the literature reveals no definition clearer and more comprehensive than that of Piersol who states "Connecting the various muscles and uniting them into groups, and also surrounding the entire musculature of the body and separating it from the deeper layers of the integument, are sheets of connective tissue known as fascia. These sheets are by no means isolated portions of connective tissue but are rather to be regarded as parts of the general interstitial connective tissue network which traverses all parts of the body, thickened to form more or less definite sheets standing in relation to neighboring organs. The density of the sheets varies greatly, in some regions they are imperfectly developed while in others they form dense, glistening sheets." It is obvious that this definition does not permit the inclusion under the term fascia of tissue in which smooth muscle predominates, regardless of its gross appearance.

The fibrous interstitial connective tissues of the body may be divided into two classes (1) loose fibrous, or areolar tissue, which occurs throughout the body wherever the exposed parts, although connected, enjoy considerable mobility. Familiar examples are the sheets or tracts of yielding connective tissue which lie beneath the skin and the underlying fascia, that unite the muscles, and that assist in keeping the viscera in place. In this type of tissue the variable bundles of white fibers are loosely and irregularly disposed, crossing in all directions and enclosing correspondingly

¹ Read by invitation before American Gynecological Society May 20 1930

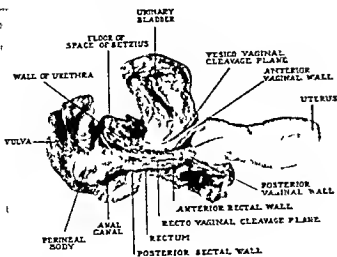


Fig 1 Photograph of the fixed gross specimen from which the microscopic sections were made. Note the loose attachment of the vaginal wall to bladder wall and rectal wall and the firm attachment of the anterior vaginal wall to the wall of the urethra

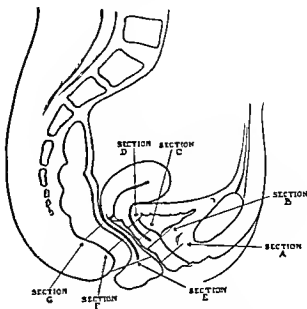


Fig 2 Microscopic cross sections were made at the levels indicated in the above diagram

irregular clefts. The elastic fibers form a network of highly refracting threads which, in section and teased preparation, are more or less wavy and curled. The cellular constituents of the normal tissue are relatively inconspicuous, but here and there the fixed connective tissue cells are seen as spindle shaped or irregular plate-like bodies and the free cells usually as rounded forms. In the inter-fascicular spaces are the tissue fluids, and in the fluids the free cells migrate. (2) Dense fibrous tissue which owes its characteristics to the more compact and orderly arrangement of the bundles of white fibers. Although the individual fibers are no thicker than in areolar tissue, they are grouped into larger bundles and held more closely together by the interfibrillary cement or ground substance. The bundles are disposed with greater regularity as intimately felted bands which form fibrous sheets termed fascia (Piersol).

In view of the fact that the constituent elements of loose and dense fibrous tissue are alike, and since the significant difference between the two types is found in the arrangement of the white fibers, it seems logical and desirable to speak of two types of fascia: an areolar type which surrounds and aids in the maintenance of the viscera, blood vessels, and nerves in their normal positions, and a denser type which sheathes and unites the voluntary

muscles of the body. My conclusions have been based upon such a classification.

The specimen (Fig 1) upon which the present study has been based consisted of the uterus and vagina, the bladder and urethra, the rectum and anal canal, the perineum and vulva, and parts of the levatores ani muscles. It was removed from the body of an exceptionally well formed and developed nullipara, 27 years of age, 16 hours after a sudden death caused by a thoracic injury. Immediately after removal, the specimen was placed in formalin for a period of 7 days, and an attempt was then made to bisect it in the sagittal plane of the body. Fortunately, the section passed slightly to the right of the sagittal plane with the result that the urethra remained intact in the left half of the specimen which was used for the histological examination. Cross sections were made at a right angle to the long axis of the vaginal canal at two levels through the anterior vaginal wall and the wall of the urethra, at two levels through the anterior vaginal wall and the adjoining wall of the bladder, at one level through the posterior vaginal wall and the wall of the rectum (Fig 2). The microscopic sections were stained by (1) eosin and hematoxylin, (2) van Gieson for connective tissue, (3) elastic tissue stain.

An examination of the gross specimen (Fig 1) reveals two points of practical impor-

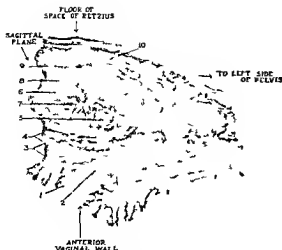


Fig 3 Low power photomicrograph of cross section A which passes through the anterior vaginal wall and the urethral wall at a level just above the point at which the urethra penetrates the superior layer of the triangular ligament of the perineum 1 Stratified squamous epithelium of vaginal mucosa, 2, fibro elastic tunica propria of vaginal mucosa 3 muscular coat of vaginal wall 4 muscular coat of urethral wall 5, urethral glands 6 tunica propria of urethral mucosa 7 urethral mucosa 8 and 9 muscular coats of urethral wall 10 extrinsic voluntary muscle fibers of urethral wall

tance If the anterior vaginal wall is examined throughout its extent it will be found that in its lower part, where it is in contact with the urethral wall, the union of the two walls is a very firm one with no natural line of cleavage between them, while in its upper part, where it is in contact with the wall of the bladder, the union between the two walls is a very loose one The vaginal wall and the bladder wall are loosely held together by a layer of areolar connective tissue Bissell and Rawls have emphasized the practical importance of entering and following this avascular line of loose attachment when separating the vaginal wall from the bladder wall in operations for cystocele By following it the vaginal wall can be kept intact If the posterior vaginal wall is examined throughout its extent, it will be found to be very loosely attached to the wall of the rectum from above downward until the point at which the rectum begins to turn backward to become the anal canal is reached At that point the rectal and vaginal walls become very firmly united This avascular line of loose attachment is similar to the one between



Fig 4 High power photomicrograph of vaginal wall and urethral wall from cross section A 1, Stratified squamous epithelium of vaginal mucosa 2, fibro elastic tunica propria of vaginal mucosa, 3 muscular coat of vaginal wall, 4 muscular coat of urethral wall 5 tunica propria of urethral mucosa 6 epithelium of urethral mucosa 7, urethral gland

the vaginal wall and the wall of the bladder Between the vaginal wall and the walls of the bladder and rectum there is a natural line of cleavage, while there is no such line between the anterior vaginal wall and the wall of the urethra

EXAMINATION OF MICROSCOPIC SECTIONS

Section A (low power photomicrograph, Fig 3, and high power photomicrograph, Fig 4) is a cross section through the anterior vaginal wall and the walls of the urethra at a level slightly above the point at which the urethra penetrates the superior layer of the triangular ligament An examination of the section from below upward reveals the mucosa of the anterior vaginal wall which is composed of a layer of stratified squamous epithelium and a fibro elastic tunica propria Above the vaginal mucosa is the muscular coat of the

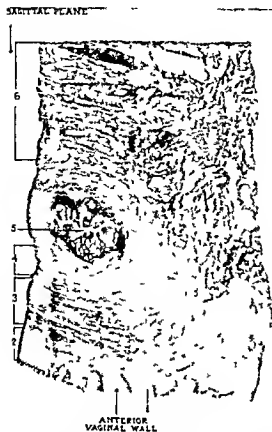


Fig 5 Low power photomicrograph of cross section *B* which passes through the anterior vaginal wall, the wall of the urethra, and part of the adjoining bladder wall at a level where the urethra is passing through the bladder wall 1, Stratified squamous epithelium of vaginal mucosa, 2, fibro-elastic tunica propria of vaginal mucosa, 3, muscular coat of vaginal wall, 4, muscular coat of urethral wall, 5, urethral canal, 6, part of muscular coat of bladder



Fig 6 High power photomicrograph of anterior vaginal wall and urethral wall from cross section *B* 1, Stratified squamous epithelium of vaginal mucosa 2, fibro-elastic tunica propria of vaginal mucosa, 3 muscular coat of vaginal wall 4 muscular coat of urethral wall

vaginal wall, the smooth muscle fibers of which are arranged in an inner circular and an outer longitudinal layer. Above the muscular coat of the vaginal wall is the muscular coat of the anterior urethral wall with its smooth muscle fibers arranged in an outer circular and an inner longitudinal layer. Adjoining the muscular coat of the urethral wall is the urethral mucosa which is composed of a mixed type of urethral epithelium and a fibro-elastic tunica propria. Above the lumen of the urethra is the posterior urethral wall, and above it a layer of extrinsic voluntary muscle fibers which have extended upward from the compressor urethrae muscle. Beyond the zone of voluntary muscle is a thin layer of fibrous tissue. It is a noteworthy fact that in this section there is no tissue in the wall of the vagina or in the wall of the urethra which is termed fascia by histologists. Certainly, there

is no fascia between the wall of the vagina and the wall of the urethra, since the muscular coat of one fuses with the muscular coat of the other. An identical condition has been found in a similar section from another body which was primarily prepared for a study of the urethral epithelium, but in which the walls of the urethra and vagina are intact and in a normal relationship. In section *A*, a little below the junction of the muscular coat of the vagina and that of the urethral wall, there are several streaks where the stain has been unusually intense. This might lead one to believe that the tissue so stained is fascia, but the microscopic examination shows it to be intensely stained smooth muscle.

Section *B* (low power photomicrograph, Fig 5, and high power photomicrograph, Fig 6) is a cross section through the anterior vaginal wall, the walls of the urethra, and part of the wall of the bladder at a point where the urethra passes through the bladder wall. An

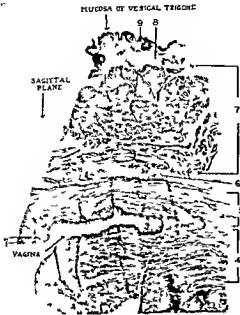


Fig 7 Low power photomicrograph of cross section C which passes through the anterior vaginal wall and the bladder wall at the midpoint of the vesical trigone 1, Stratified squamous epithelium of vaginal mucosa 2 fibro elastic tunica propria of vaginal mucosa 3 left side of vaginal canal 4 muscular coat of posterior vaginal wall 5 muscular coat of anterior vaginal wall 6 vesicovaginal layer of areolar fascia 7 muscular coat of bladder wall 8 tunica propria of vesical mucosa 9 transitional epithelium of vesical mucosa

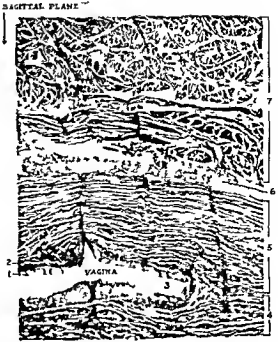


Fig 8 High power photomicrograph of anterior vaginal wall and adjoining bladder wall from cross section C 1 Stratified squamous epithelium of vaginal mucosa 2 fibro elastic tunica propria of vaginal mucosa 3 left side of vaginal canal 4 muscular coat of posterior vaginal wall 5 muscular coat of anterior vaginal wall 6 vesico vaginal layer of areolar fascia 7 muscular coat of bladder wall

examination of the section from below upward shows the vaginal mucosa composed of a layer of stratified squamous epithelium and a fibro elastic tunica propria above which is the muscular coat of the vaginal wall Above the smooth muscle of the vaginal wall is found the muscular coat of the urethra, and above this the mucosa of the urethra which is composed of a mixed type of epithelium and a fibro elastic tunica propria Above the urethral canal is the posterior urethral wall and above that the smooth muscle of the bladder wall As in section A, there is no tissue in the wall of the vagina or in the wall of the urethra which is termed fascia by histologists In this section also there is no fascia between the vaginal wall and the urethral wall

Section C (low power photomicrograph, 7, and high power photomicrograph, 8) is a cross section through the anterior wall and the adjoining wall of the at the midpoint of the vesical trigone

It also includes part of the posterior vaginal wall It is to be noted that the section extends well beyond the left side of the vagina An examination of the section from below upward reveals part of the posterior vaginal wall above which can be seen the lumen of the vagina The mucosa of the anterior vaginal wall consists of a layer of stratified squamous epithelium and a narrow fibro elastic tunica propria above which is the muscular coat of the vagina The muscle fibers of this coat are arranged principally in a circular layer Pier sol points out the fact that the classical arrangement of the muscle fibers of the vaginal wall in an inner circular and an outer longitudinal layer is not always encountered The arrangement of the smooth muscle in this section may therefore be considered normal Above the muscular coat of the vaginal wall there is a thin layer of areolar connective tissue, and above that is the muscular coat of the bladder wall with the bundles of muscle



Fig 9 Low power photomicrograph of cross section *D* which passes through the anterior vaginal wall and the bladder wall at a point just below the vesicocervical junction. 1, Stratified squamous epithelium of vaginal mucosa, 2, fibro elastic tunica propria of vaginal mucosa, 3, muscular coat of vaginal wall, 4, vesicovaginal layer of areolar fascia, 5, muscular coat of bladder wall, 6, tunica propria of vesical mucosa, 7, epithelium of vesical mucosa

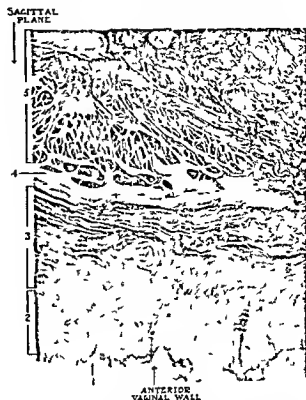


Fig 10 High power photomicrograph of anterior vaginal wall and adjoining bladder wall from cross section *D*. 1, Stratified squamous epithelium of vaginal mucosa, 2, fibro elastic tunica propria of vaginal mucosa, 3, muscular coat of vaginal wall, 4, vesicovaginal layer of areolar fascia, 5, muscular coat of bladder wall

fibers sectioned in different planes. Above the muscular coat is the mucosa of the vesical trigone which is composed of transitional epithelium and a loosely arranged fibro elastic tunica propria. It is to be noted that in this section the muscular coat of the anterior vaginal wall and the muscular coat of the bladder wall do not fuse as did the muscular coat of the vaginal wall and the muscular coat of the urethral wall in the two preceding sections, A and B, but that the muscular coat of the vaginal wall and the muscular coat of the bladder wall are distinctly separated by a thin layer of areolar connective tissue to which the term areolar fascia can logically be applied, since this loosely arranged fibrous tissue is composed of the fibers and cells essential to the structure of a fascia. The application of the term fascia to this tissue is in accord with the definition followed throughout the present study.

Section *D* (low power photomicrograph, Fig 9, and high power photomicrograph,

Fig 10) is a section through the upper portion of the anterior vaginal wall and the adjoining wall of the bladder just below the cervicovesical junction. An examination of the section from below upward shows the mucosa of the anterior vaginal wall which is composed of a layer of stratified squamous epithelium and a fibro-elastic tunica propria. Above the mucosa is the muscular coat of the vaginal wall, and above that there is a thin layer of fascia of the areolar type. Above this fascia is the muscular coat of the bladder wall, and above the muscular coat is the mucosa which is composed of a tunica propria and the characteristic transitional epithelium. In this section, as in all of the preceding ones, there is no tissue either in the vaginal wall or the bladder wall which is termed fascia by histologists.

Section *E* (low power photomicrograph, Fig 11, and high power photomicrograph, Fig 12) is an oblique section through the posterior vaginal wall, the anterior rectal wall as

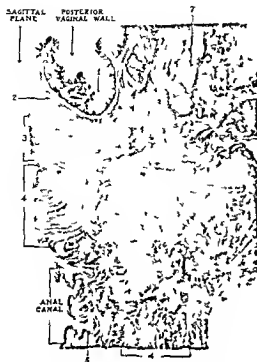


Fig. 1. Low power photomicrograph of section *F* which passes obliquely through the posterior vaginal wall, the muscular coat of the anterior rectal wall, and the wall of the anal canal at a level just above the point where the vagina attaches to the superior layer of the triangular ligament. 1 stratified squamous epithelium of vaginal mucosa, 2 fibro-elastic tunica propria of vaginal mucosa, 3 muscular coat of vaginal wall, 4 muscular coat of rectal wall and wall of anal canal, 5 mucosa of anal canal, 6 part of levator ani muscle, 7 vulvovaginal gland.

it turns backward to become the anal canal, and the wall of the anal canal. An examination of the section from above downward shows the mucosa of the posterior vaginal wall which is composed of a layer of stratified squamous epithelium and a fibro-elastic tunica propria. Beneath the vaginal mucosa is the muscular coat of the vaginal wall fusing with the musculature of the rectal and anal walls. Beneath the smooth muscle of these walls is the submucosa and the mucosa of the anal canal. There is no fascia between the vaginal wall and the wall of the anal canal.

Section *F* (low power photomicrograph, Fig. 13, and high power photomicrograph, Fig. 14) is a cross section through the posterior vaginal wall and the rectal wall at a point midway between the upper and lower ex-



Fig. 12. High power photomicrograph of posterior vaginal wall, the muscular coat of the anterior rectal wall and the wall of the anal canal from section *F*. 1 stratified squamous epithelium of vaginal mucosa, 2 fibro-elastic tunica propria of vaginal mucosa, 3 muscular coat of vaginal wall, 4 muscular coat of anterior rectal wall and wall of anal canal, 5 vulvovaginal gland.

tremities of the vagina. An examination of the section from above downward reveals the mucosa of the posterior vaginal wall which is composed of a layer of stratified squamous epithelium and its tunica propria. Beneath the mucosa is the muscular coat of the posterior vaginal wall. Separating the muscular coat of the vagina from the muscular coat of the rectal wall is a layer of fascia which is of the areolar type in places and of a denser type in others as it passes laterally toward the levator ani muscle and backward to surround the rectal wall. In its denser portion it contains some smooth muscle fibers which run into it from the muscular coat of the vaginal wall. Below the muscular coat of the rectal wall is the submucosa and the rectal mucosa. At the right side of the section part of the levator ani muscle can be seen. Its superior surface is covered by a layer of dense fascia—the superior



Fig 13 Low power photomicrograph of cross section *F* which passes through the posterior vaginal wall and the rectal wall at the midpoint of the posterior vaginal wall 1, Stratified squamous epithelium of vaginal mucosa, 2, muscular coat of vaginal wall, 3, muscular coat of rectal wall, 4, submucous coat of rectal wall, 5, rectal mucosa, 6, rectal layer of the fascia endopelvina 7, superior fascia of pelvic diaphragm (superior levator fascia), 8, lateral portion of the perivaginal fascia, 9, levator ani muscle, 10, rectovaginal layer of areolar fascia

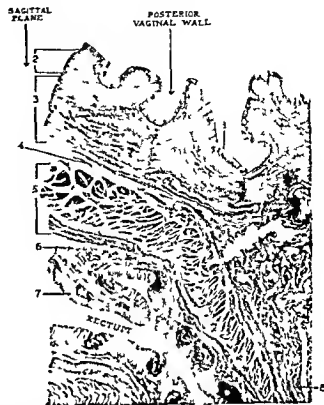


Fig 14 High power photomicrograph of the posterior vaginal wall and rectal wall from cross section *F* 1, Stratified squamous epithelium of vaginal mucosa, 2, fibro elastic tunica propria of vaginal mucosa, 3, muscular coat of vaginal wall, 4, rectovaginal layer of areolar fascia, 5, muscular coat of rectal wall, 6, submucous coat of rectal wall, 7, rectal mucosa, 8, rectal layer of fascia endopelvina

fascia of the pelvic diaphragm—which is in contact with the lateral portion of the fascia which surrounds the vagina Halban has emphasized the fact that the fascia which covers the superior surface of the levator ani muscle does not send layers of fascia inward to surround the pelvic viscera (Fig 18) It is obvious that this contention is substantiated by conditions in this section There is in this as in all of the preceding sections no tissue in the wall of the vagina or the wall of the rectum which is termed fascia by histologists Between the vaginal wall and the rectal wall there is a layer of fascia which in places is of the areolar type and in others of a denser type

Section G (low power photomicrograph, Fig 15, and high power photomicrograph, Fig 16) is a cross section through the posterior lip of the cervix, the upper extremity of the posterior vaginal wall just below the attach-

ment of the vaginal wall to the cervix, and the rectal walls An examination of the section from above downward reveals a part of the posterior lip of the cervix Below this is the mucosa of the posterior vaginal wall which is composed of the usual layer of stratified squamous epithelium and a thin tunica propria Beneath the mucosa is the muscular coat of the vagina which is separated from the muscular coat of the rectal wall by a broad zone of loosely arranged fascia of the areolar type Beneath this layer of fascia is the muscular coat of the rectal wall with its fibers arranged in an inner circular and an outer longitudinal layer The muscular coat of the rectal wall is separated from the characteristic rectal mucosa by a thin submucosa In this section there is no tissue in either the vaginal wall or the rectal wall which is termed fascia by histologists Between the muscular coat of the vaginal wall and the muscular coat

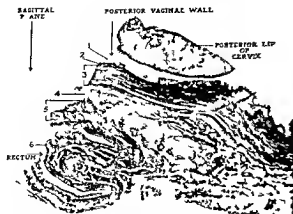


Fig 15 Low power photomicrograph of cross section *G* which passes through the posterior lip of the cervix the posterior vaginal wall and the wall of the rectum just below the cervicovesical junction 1 Stratified squamous epithelium of vaginal mucosa 2 fibro elastic tunica propria of vaginal mucosa 3 muscular coat of vaginal wall 4 rectovaginal layer of areolar fascia 5 muscular coat of rectal wall 6 rectal mucosa

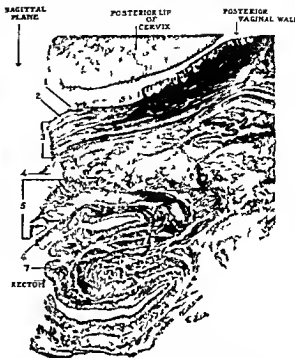


Fig 16 High power photomicrograph of the posterior vaginal wall and wall of the rectum from cross section *G* 1 Stratified squamous epithelium of vaginal mucosa 2 fibro elastic tunica propria of vaginal mucosa 3 muscular coat of vaginal wall 4 rectovaginal layer of areolar fascia 5 muscular coat of rectal wall 6 submucous coat of rectal wall 7 rectal mucosa

of the rectal wall there is a broad zone of fascia of the areolar type which extends laterally beneath the vaginal wall as it broadens in the vault

The findings in the sections described may be briefly summarized by saying that there is no tissue in the walls of the vagina, urethra, bladder anal canal, and rectum which is termed fascia by histologists. There is no fascia between the vaginal wall and the wall of the urethra. There is, on the contrary a thin layer of loosely arranged fascia of the areolar type between the anterior vaginal wall and the wall of the bladder, and between the posterior vaginal wall and the wall of the rectum. These two layers of areolar fascia unite at the sides of the vagina to form the pervaginal fascia.

The application of the term fascia to the thin layer of loosely arranged fibro elastic tissue which separates the vaginal wall from the walls of the bladder and rectum may be challenged. If so, the use of the term may be defended on two grounds. First, this tissue differs from the denser form of connective tissue commonly known as fascia only in the arrangement and number of the white fibers, second, it is continuous with and similar to that important retroperitoneal layer of connective

tive tissue which is found about and between the pelvic viscera, and which is termed fascia endopelvina.

It is desirable at this point to review briefly the gross anatomy of the fascia which surrounds the vagina. For the first lucid description of the fascial system of which the pervaginal fascia is a part and also of the other fascia of the pelvis, credit must be given to Halban who contends that there are two distinct systems of fascia in the pelvis, one which forms sheaths for the voluntary pelvic muscles (muscle fascia) and the other which partly or completely surrounds and separates the pelvic viscera (fascia endopelvina, Fig 17 and Fig 18). Halban emphasizes the fact that the endopelvic fascia, though laterally in contact with and loosely attached to the muscle fascia which covers the superior surface of the levator ani muscle (superior fascia of the pelvic diaphragm), is not a part of it.

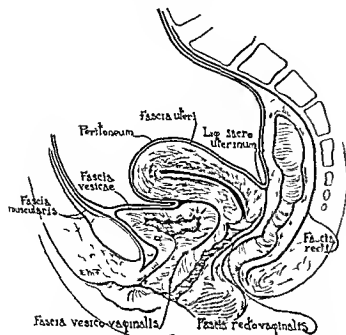


Fig 17 Sagittal section of pelvis which shows the muscle fascia and the fascia endopelvina (Modified and redrawn from Halban)

In other words, the fascia which covers the superior surface of the levator muscle does not send layers of fascia inward to surround the pelvic viscera, but continues downward and inward over the surface of the muscle to join the corresponding layer of fascia from the opposite side in a common raphe behind the rectum. According to Halban's description, the perivaginal fascia is a part of the fascia endopelvina.

Halban has also suggested a meaningful terminology for the various layers of the fascia endopelvina. To that layer of areolar fascia which separates the anterior vaginal wall from the adjoining bladder wall the term vesico-vaginal fascia is given. To the layer of areolar fascia which separates the posterior vaginal wall from the wall of the rectum the term recto-vaginal fascia is given. The vesicovaginal layer and the rectovaginal layer unite at the sides of the vagina to form the perivaginal fascia, or the perivagina fibrosa, as it is termed by Halban. It is obvious that such terms are indicative of the location of the various layers of this fascia.

Histologists speak of the fibrous coat of the vagina and of the bladder. An examination of the sections herein illustrated shows that the fibrous coats of these structures are but

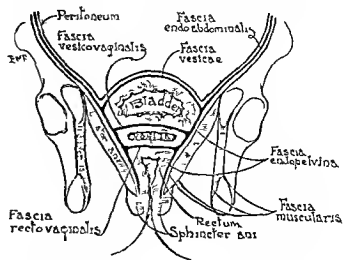


Fig 18 Frontal section of pelvis which shows the muscle fascia and the fascia endopelvina (Modified and redrawn from Halban)

parts of the loosely arranged fascia which separates them. When the histologist separates the bladder wall from the vaginal wall, and examines them separately, he finds a small amount of the fascia adherent to the muscular coat of each. To this thin zone of adherent connective tissue he gives the term fibrous coat.

Finally, in presenting the study herein described, I admit that the findings in a single specimen of any sort do not establish incontrovertible facts. However, taking into consideration that the specimen which has been studied was removed intact from the body of a remarkably well formed and developed young nullipara, and also that the tissues throughout the specimen have conformed closely to the classical descriptions as given by histologists, it is reasonable to believe that the conditions found in this specimen are in all probability indicative of those which exist in the usual normal nullipara.

CONCLUSIONS

1. In the normal nullipara there is no tissue in the walls of the vagina, urethra, bladder, and rectum which can logically be termed fascia, if the classical histologic descriptions of the tissues are observed.
2. There is no fascia between the anterior vaginal wall and the wall of the urethra.
3. There is a thin layer of fascia of the areolar type between the anterior vaginal

wall and the wall of the bladder. There is a similar layer of areolar fascia between the posterior vaginal wall and the wall of the rectum.

4 The layer of areolar fascia which separates the anterior vaginal wall from the wall of the bladder (vesicovaginal fascia) and the layer of areolar fascia which separates the posterior vaginal wall from the wall of the rectum (rectovaginal fascia) unite at the sides of the vagina to form the perivaginal fascia, which is a part of the fascia endopelvina.

5 The areolar character of the fascia which separates the vaginal wall from the walls of the bladder and rectum makes it impossible to dissect it as an individual layer, and as such to use it in vaginal plastic operative procedures. If used at all, it must be used in conjunction with the overlying wall of the vagina.

6 There is no fascia other than the areolar perivaginal fascia available for use in the surgical correction of cystocele and rectocele.

7 The successful surgical correction of cystocele, rectocele, and urethrocele depends on the utilization of the tissues of the vaginal wall rather than on the use of the fragile areolar fascia which surrounds it.

8 When using the term fascia in descriptions of vaginal plastic operations it is important to stress the fact that the fascia referred to is not of the dense type, such as is the

sheath of the rectus muscle, but that it is of the loosely arranged areolar type.

9 It is apparent that many gynecologists have applied the term fascia to the muscular coat of the vaginal wall, which is situated just beneath the vaginal mucosa, because it somewhat resembles a layer of dense fascia in its gross appearance. It is obvious that such use of the term fascia is not in accord with classical histological description of the tissues which constitute the vaginal wall.

10 The abandonment of an inaccurate terminology which is based on the gross appearance of the tissues, and the adoption of one based on the established histology of the tissues in and about the walls of the vagina, urethra, bladder, and rectum, will lead to a clearer common understanding of the problems of cystocele, rectocele, and urethrocele, and will facilitate the teaching of vaginal plastic surgery.

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GRAVES' CONSTITUTION (WARTHIN)

C. ALFRED HILLWIG M.D. WICHITA, KANSAS
 from the Department of Pathology St. Francis Hospital Wichita, Kansas

THE modern surgical treatment of Graves' disease has its scientific foundation in the thyreogenic theory of Moebius, that a pathological secretion of the thyroid gland is the underlying factor. It is generally accepted that the therapeutic success depends on the removal of a portion of the diseased organ, large enough to inhibit the increased or perverted secretion.

In a very interesting paper, Warthin comes to the opposite view—that thyroid hypersecretion is not the primary pathogenic factor in this disease, but that the thyroid gland is only one of many other organs, secondarily involved in a constitutional abnormality. By analyzing a material of 976 resected thyroid glands, he demonstrated, in 401 specimens obtained from cases which were clinically diagnosed as exophthalmic goiter or toxic adenoma, as the only constant histological feature the presence of hyperplastic lymph follicles, not only in the glands with epithelial hyperplasia, but also in 93 cases in which the latter was completely absent.

From a further study of 1,000 thyroid glands at autopsy he found that all cases with lymphoid hyperplasia in the thyroid gland (94) and 35 additional cases of exophthalmic goiter were associated with the general picture of the thymicolymphatic constitution. Warthin considers, therefore, the presence of lymph follicles in the thyroid gland as evidence of a status thymicolymphaticus which is the underlying factor of every case of Graves' disease and so-called toxic adenoma. An adenoma of the thyroid, in his opinion, is clinically important, as far as so-called toxic symptoms are concerned, only when it is associated with this diathesis. He comes to the practical conclusion that there is, of course, no cure for any primary constitutional defect by operation, as the stigmata of the latter will persist.

Simpson studied a material of 665 resected thyroid glands and found that of these, 265 exophthalmic goiters and 121 adenomatous

colloid goiters with toxic symptoms showed only one constant histological finding—lymphoid hyperplasia in the thyroid gland, whereas epithelial hyperplasia was absent in 95 specimens. Of 265 autopsies, 47 cases presented the evidence of thymicolymphatic constitution and in all but 2 the thyroid gland was rich on lymphoid tissue. Simpson agrees, therefore, with Warthin, that all cases of Graves' disease and so-called toxic adenoma possess an identical underlying constitutional abnormality,—the thymicolymphatic diathesis, that these individuals are consequently predestined from birth to hyperthyroidism, and that the disturbance in the morphology and function of the thyroid gland is but one manifestation of an abnormality involving many other structures, which is called "Graves' constitution (Warthin)."

Groups of lymphocytes in the thyroid gland were described as an important feature of the exophthalmic goiter by the earliest students of this disease—Askanazy, Farmer, F. Mueller. McCallum was the first who called attention to lymph follicles with germinal centers as typical findings in exophthalmic goiter. His observations were confirmed later by A. Kocher, Simmonds, v. Werdt, Zander, Oehler, Pettavel, Roussy and Clunet, Vogel, Marine and Lenhart. There was, however, no unanimity of opinion in regard to the frequency of lymphoid hyperplasia in exophthalmic goiter. A. Kocher and Simmonds predicated the occurrence of lymphoid hyperplasia in about 80 per cent, Troell in 90 per cent, while v. Werdt found it only in one-half of his typical cases, and much less in his atypical cases. In the latter, Simmonds observed groups of lymphocytes in only 16 per cent. In Wegelin's material of exophthalmic goiter, 91 per cent presented lymphoid tissue the incidence and amount of which were in direct proportion to the epithelial hyperplasia and in inverse proportion to the amount of colloid.

Extensive studies by Simmonds have further shown that lymphocytes may be



Fig 1 Non proliferant diffuse colloid goiter. The projections of the acinar wall indicate that the diffuse colloid goiter is not due to simple pressure distention of normal acini by colloid, but to an active hyperplastic process.

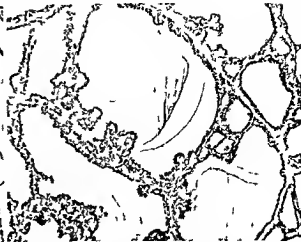


Fig 2 Proliferant diffuse colloid goiter. Marked epithelial hyperplasia in the large acini. This specimen was taken from a case of severe hyperthyroidism (without exophthalmos).

present even in the normal thyroid gland. As a rule, they were small and oval or round in form, in addition to lymphocytes, plasma cells were present and in one third of the positive cases Simmonds described typical lymph follicles with germinal centers. As to the frequency of these changes, Simmonds saw lymphoid tissue in 5 per cent of normal thyroid glands, mostly after the sixtieth year of life, whereas the first two decades were almost free. The female sex predominated and constituted about four fifths of all his positive cases. The theory advanced by v. Gierke and Borchardt that this lymphoid tissue in the thyroid gland is a manifestation of status thymicolymphaticus was opposed by Simmonds, v. Werdt, and Wegelin because they were unable to find such manifestation in the thyroid glands of typical cases suffering from this constitutional defect, and practically never in childhood, the favorite age for this abnormality.

As the lymphoid tissue is rather frequent in thyroids of older women who are anæmic and adipose, Hacker was of the opinion that there might be some relation to the function of the ovaries. Wegelin, on the other hand, considers the adrenals responsible in some cases, as he saw lymphocytes in the thyroid gland of patients with Addison's disease.

Langhans, Zuellig, Zehbe, Hedinger, and others described groups of lymphocytes in

malignant goiter and Hashimoto, Bruenger, Reist, and v. Werdt in cases of chronic thyroiditis.

From all these different observations Wegelin comes to the conclusion that lymphoid tissue develops in the thyroid gland as a purely local response to chemical, mechanical, or bacterial irritation and that there is not any positive proof that it is due to a thymicolymphatic constitution.

The object of our study was to determine whether Warthin's and Simpson's observations could be confirmed by our own findings. The material examined consisted of 53 thyroid glands removed at St. Francis Hospital by operation, and of 7 thyroid glands obtained at autopsy.

The clinical and microscopic diagnoses of our operative material are tabulated in Table I, in which Aschoff's classification is followed. Of our 15 diffuse colloid goiters 8 belonged to the simple and 7 to the proliferative form. Both groups had large acini, filled with well stained colloid, but in the proliferative form the epithelial wall of the follicles showed more foldings and cushion like elevations, the lumina appeared irregular, and beneath the epithelial lining of the projections many very small acini were formed. This proliferant colloid goiter showed transitions to the exophthalmic goiter by still higher proliferations of



Fig. 3 "Primary" exophthalmic goiter. Small areas of epithelial hyperplasia in a diffuse colloid goiter.

the acinar wall, whereby the lumina became narrow, branching ducts.

Marine and Lenhart attempted to differentiate primary and secondary exophthalmic goiter, the first originating in a normal, the other in a goitrous gland. The expediency of this division seems questionable. From my own studies, not alone of this material, but also of many glands from patients of European extraction, I am forced to the belief that exophthalmic goiter develops usually in a diffuse colloid goiter. All of the thirteen exophthalmic goiters examined in this paper presented on the cut surface either throughout or in patches an amber red and translucent appearance suggesting a colloid rich tissue. Histologically in every instance, areas with large colloid-filled acini were present either with or without proliferation of the acinar wall. That these changes are not due to an involution caused by Plummer's treatment is indicated by the fact that I saw them also in European material and in exophthalmic goiters obtained from Dr. Hertzler's clinic which were resected prior to the era of pre-operative ligation.

Marine's statement that every diffuse colloid goiter develops from epithelial hyperplasia of the thyroid gland by involution, should be replaced by the conception that diffuse colloid goiter and exophthalmic goiter are two nearly related stages of thyroid activity and that one of them can easily change into the other.



Fig. 4 Nodular hyperplasia (Wegelin) representing a transitional stage between diffuse and nodular colloid goiter. Clinically a mild hyperthyroidism was present.

Epidemiological statistics are in favor of this opinion, since diffuse colloid goiter, with or without hyperthyroidism, is commonly associated in the same locality with Graves' disease, but there is little statistical evidence in regard to its association with congenital goiter and cretinism. In more mountainous countries the thyrotoxic goiter is an exception and the nearer one approaches the center of the endemic area the less he meets with



Fig. 5 Nodular colloid goiter. The epithelial proliferations in the nodule are not in favor of Plummer's theory that these colloid nodules are merely sequelae to accumulation of colloid and involution of the gland.

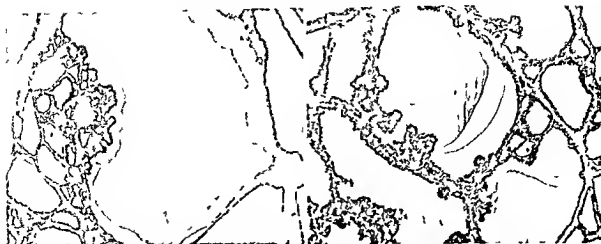


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Fig 8 Lymphoid tissue in exophthalmic goiter. No typical lymph follicles were found



Fig 9 Lymph follicles with germinal centers in a diffuse microfollicular goiter without any thyreotoxic symptoms

the histogenesis of the colloid nodules, we may say that our experience does not confirm the view held by Rienhoff that these structures are merely regressive sequelæ of a previous diffuse hyperplasia, due to pressure distention of acini with colloid. We believe that these nodules originate, like the diffuse colloid goiters, as a proliferative process from a pre-existing thyroid pattern. We have to regard, therefore, the terms "non-proliferative" and "proliferative" colloid goiter only as different grades of the same pathological process, and we must use great care in drawing conclusions concerning the function of a nodular gland, since it seems almost impossible in a specimen with many, sometimes over a hundred nodules, to get a correct impression of the histological character of the whole gland, by examining sections from only a few different areas.

Of our 51 benign goiter cases, 14 were clinically diagnosed as exophthalmic goiter and 22 as toxic adenomata. Only 10 of the latter showed nodules anatomically, the other 12 were diffuse colloid goiters. From this it is apparent that the clinical diagnosis "toxic adenoma" does not refer to the anatomical structure at all, but only to the absence of eye symptoms in the patient. It would be logical to omit, therefore, this misleading name and designate these cases with a purely clinical diagnosis "hyperthyroidism

without eye signs." The diagnosis of exophthalmic goiter was made by the clinician 14 times, and of these the anatomical examination revealed in 2 cases diffuse colloid goiter without epithelial proliferation, in 4, proliferant colloid goiter, and in 8, exophthalmic goiter, which showed islands of solid epithelial hyperplasia within a diffuse colloid goiter. No adenomatous gland was found in this group. Protrusion of the eyes was absent in 5 of the 13 patients, whose thyroid glands were typical exophthalmic goiters. We regard, therefore, exophthalmic and so-called toxic goiter as different stages of the same pathological entity, i.e., hyperthyroidism. In Table I three grades of hyperthyroidism are distinguished: xxx, severe hyperthyroidism with exophthalmos, xv, severe hyperthyroidism without exophthalmos, x, mild hyperthyroidism, * goiter without hyperthyroidism.

In the group of nodular colloid goiter, no case belonged to the severest form of hyperthyroidism, 1 to the second grade, and 5 to the mild grade of hyperthyroidism. In our material, parenchymatous nodular goiter (fetal adenoma) never produced thyreotoxicosis, with the exception of one case. In this the clinician had diagnosed toxic adenoma, but the enucleation of the single adenoma did not bring any relief from the toxic symptoms, and the basal metabolism was still 25 per cent

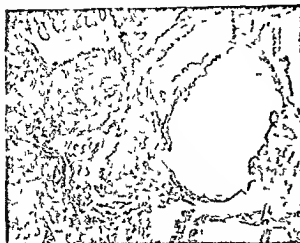


Fig 10 Exophthalmic goiter originating in diffuse colloid goiter. The lymphocytic infiltration is limited to the hyperplastic cellular area.



Fig 11 Thyroid gland of a typical case of status thymicolymphaticus. There is no lymphoid tissue in the thyroid gland.

above normal, 1 year after the operation. We assume that in this case hyperplastic changes in the non-resected thyroid tissue proper were responsible for the clinical symptoms, a point brought out recently in a valuable study by Rienhoff.

In Table III are tabulated the findings showing the relation of lymphoid tissue to the epithelial structure of the gland and in Table IV the same to the clinical diagnosis. All but one of our typical exophthalmic goiters with marked epithelial hyperplasia showed lymphoid tissue. It was found either in the crossings of the interlobular septa, or invading the periphery of the lobules, the acini being compressed. In 5 of these specimens there were rather small and infrequent groups of lymphocytes with some plasma cells, in 7 their size was considerable, and in 3 of the 13 cases, typical lymph follicles with germinal center were present, including reticulum cells and lymphoblasts. The only case in which the most careful search failed to detect lymphoid tissue was a 29 year old man with a severe form of Graves' disease of 5 months' duration. The basal metabolism was 72 per cent above normal and dropped after iodine administration to 17 per cent. The gland was a diffuse colloid goiter with many islands of dense epithelial hyperplasia. Groups of lymphocytes were present in 71.3 per cent of the proliferative diffuse colloid goiters and in 1 we

found typical lymph follicles, of the non-proliferant forms of diffuse colloid goiter only one third had positive findings, none of these glands showed typical lymph follicles.

In the 2 cases of nodular hyperplasia (Wegelin) and in 5 of the 10 nodular colloid goiters we were unable to detect any lymphoid infiltration. In the 5 positive cases the lymphoid tissue was only scanty and never within the nodules, but only in the surrounding parenchyma proper, which was compressed by the growing colloid nodules. One of the parenchymatous nodular goiters showed small groups of lymphocytes, near the capsule of an adenoma.

From Table IV we learn the most important relationship between the frequency of lymphoid tissue and the clinical diagnosis. Comparing our findings with those of Warthin and Simpson, we were surprised that of our 14 cases of Graves' disease only 71.4 per cent had lymphoid tissue in their thyroid gland, although we examined many sections from different parts of the resected gland. The second group in Table IV includes our severe grades of hyperthyroidism without eye signs, and the microscopic examination revealed lymphocytes in 69 per cent, in the third group of mild hyperthyroidism, only 55 per cent had positive findings. Still more surprising were our findings in the cases of goiter without thyrotoxic symptoms. Of these

TABLE I—ANATOMICAL DIAGNOSIS, AGE, AND GRADE OF HYPERTHYROIDISM

| Simple diffuse colloid goiter | | | Nodular hyperplasia (Wegelin) | | | | | |
|------------------------------------|-----|-------|------------------------------------------------|-----|-------|--------|-----|-------|
| Sex | Age | Grade | Sex | Age | Grade | | | |
| Female | 19 | * | Female | 38 | x | | | |
| Male | 27 | xx | Female | 36 | x | | | |
| Female | 41 | xx | Nodular colloid goiter without proliferation | | | | | |
| Female | 25 | xxx | | | | | | |
| Female | 21 | xx | | | | | | |
| Female | 41 | xxx | | | | | | |
| Female | 26 | * | | | | | | |
| Female | 23 | x | Male | 38 | * | | | |
| Proliferant diffuse colloid goiter | | | Female | 39 | * | | | |
| | | | Female | 55 | x | | | |
| | | | Male | 42 | * | | | |
| | | | Female | 18 | * | | | |
| | | | Nodular colloid goiter with proliferation | | | | | |
| Sex | Age | Grade | | | | | | |
| Female | 19 | xx | | | | | | |
| Female | 23 | xxx | | | | | | |
| Male | 46 | xx | | | | | | |
| Male | 40 | x | Sex <th>Age</th> <th>Grade</th> | Age | Grade | | | |
| Male | 29 | xxx | Male | 37 | xx | | | |
| Female | 24 | xxx | Female | 25 | x | | | |
| Male | 24 | xxx | Female | 50 | x | | | |
| Exophthalmic goiter | | | Nodular parenchymal goiter | | | | | |
| | | | | | | Sex | Age | Grade |
| | | | | | | Female | 26 | xxx |
| | | | | | | Female | 28 | xx |
| | | | | | | Female | 32 | xx |
| Female | 24 | xxx | Female | 30 | * | | | |
| Female | 21 | xxx | Female | 40 | x(?) | | | |
| Female | 34 | xx | Nodular colloid and parenchymal goiter | | | | | |
| Male | 29 | xxx | | | | | | |
| Female | 32 | xx | | | | | | |
| Female | 20 | xxx | | | | | | |
| Male | 43 | xxx | | | | | | |
| Female | 27 | xxx | Sex <th>Age</th> <th>Grade</th> | Age | Grade | | | |
| Female | 42 | xxx | Male | 29 | xx | | | |
| Female | 42 | xx | Female | 30 | * | | | |
| | | | Male | 13 | * | | | |
| | | | xxx Severe hyperthyroidism with exophthalmos | | | | | |
| | | | xx Severe hyperthyroidism without exophthalmos | | | | | |
| | | | x Mild hyperthyroidism | | | | | |
| | | | * No hyperthyroidism | | | | | |

xxx Severe hyperthyroidism with exophthalmos
 xx Severe hyperthyroidism without exophthalmos
 x Mild hyperthyroidism
 * No hyperthyroidism

fully 38.5 per cent showed lymphocytic infiltration, and the greatest degree of lymphoid hyperplasia, which was observed in any of our cases, was noted in group 4. A married woman, 30 years old, who had treated the enlargement of her neck with large doses of iodine for one whole year, had a normal basal metabolism and no other signs of hyperthyroidism. After resection of 45 grams of thyroid a marked postoperative myxedema developed, which today, 3 years after operation,

still needs thyroid medication. Histologically the resected gland showed small acini with low epithelium and viscous colloid, and an enormous hyperplasia of lymph follicles. The microscopic picture corresponded to Hertzler's description of his "interstitial goiter."

The second largest amount of lymphoid tissue was seen in the adenocarcinoma of a 61 year old woman, who died of multiple metastases one year after thyroidectomy was performed.

TABLE II—PATHOLOGICAL AND ANATOMICAL DIAGNOSIS, AGE AND SEX OF OUR GOITER CASES

| Diagnosis | Age in years and sex | | | | |
|------------------------------------------------------|----------------------|-------|-------|-------|-------|
| | 12-15 | 16-19 | 20-25 | 26-45 | 46-60 |
| Small follicular hyperplasia | | | | 1F | |
| Diffuse colloid goiter without proliferation | | 1F | 4F | 1M 2F | |
| Diffuse colloid goiter with proliferation | | 1F | 2F | 2M | 1M |
| Exophthalmic goiter | | | 3F | 1M 8F | 1M |
| Nodular hyperplasia (Wegehn) | | | | 2F | |
| Nodular colloid goiter without proliferation | | 1F | | 2M 1F | 3F |
| Nodular colloid goiter with epithelial proliferation | | | 1F | 1M | 1F |
| Nodular parenchymatous goiter | | | | 2M 3F | |
| Nodular colloid and parenchymatous goiter | | | | 2M 1F | |

TABLE III—RELATIONSHIP OF LYMPHOID TISSUE IN THYROID GLAND AND ANATOMICAL DIAGNOSIS

| | Cases |
|----------------------------------------------|-------|
| Simple diffuse colloid goiter | |
| Much lymphoid tissue | 1 |
| Some lymphoid tissue | 1 |
| Scanty lymphoid tissue | 1 |
| No lymphoid tissue | 5 |
| Infiltrant diffuse colloid goiter | |
| Much lymphoid tissue | 2 |
| Scanty lymphoid tissue | 3 |
| No lymphoid tissue | 2 |
| Exophthalmic goiter | |
| Very much lymphoid tissue | 2 |
| Much lymphoid tissue | 3 |
| Some lymphoid tissue | 4 |
| Scanty lymphoid tissue | 3 |
| No lymphoid tissue | 1 |
| Nodular hyperplasia (Wegelin) | |
| No lymphoid tissue | 2 |
| Nodular colloid goiter without proliferation | |
| Some lymphoid tissue | 3 |
| Scanty lymphoid tissue | 1 |
| No lymphoid tissue | 3 |
| Nodular colloid goiter with proliferation | |
| Scanty lymphoid tissue | 1 |
| No lymphoid tissue | 2 |
| Nodular parenchymal goiter | |
| Scanty lymphoid tissue | 1 |
| No lymphoid tissue | 4 |
| Nodular colloid and parenchymal goiter | |
| Scanty lymphoid tissue | 1 |
| No lymphoid tissue | 2 |

RESULTS OF OUR STUDY

Our findings corroborate the conclusions drawn by European workers, that the lymphocytic infiltration in exophthalmic goiter is due to the pathological hyperplasia and hypersecretion of the thyroid itself. Without doubting their diagnostic value, we must keep in mind the fact that only 66 per cent of all our thyreotoxic cases presented lymphocytic groups in the thyroid gland and that, on the other hand, more than one third of the innocent goiters without clinical signs of secretory disturbance showed the same findings. From Table III it is evident that the frequency and size of the lymphocyte groups depend directly on the intensity of the hyperplasia and the decrease of the stored colloid. By studying exophthalmic goiters, in which the epithelial hyperplasia does not

TABLE IV—RELATIONSHIP OF LYMPHOID TISSUE IN THYROID GLAND AND CLINICAL DIAGNOSIS

| | Cases |
|---------------------------------------------|-------|
| Severe hyperthyroidism with exophthalmos | |
| Very much lymphoid tissue | 2 |
| Much lymphoid tissue | 2 |
| Some lymphoid tissue | 3 |
| Scanty lymphoid tissue | 3 |
| No lymphoid tissue | 4 |
| Percentage of positive findings | 71.4 |
| Severe hyperthyroidism without exophthalmos | |
| Much lymphoid tissue | 5 |
| Some lymphoid tissue | 3 |
| Scanty lymphoid tissue | 1 |
| No lymphoid tissue | 4 |
| Percentage of positive findings | 69 |
| Mild hyperthyroidism | |
| Some lymphoid tissue | 2 |
| Scanty lymphoid tissue | 3 |
| No lymphoid tissue | 4 |
| Percentage of positive findings | 55 |
| Goiter without hyperthyroidism | |
| Very much lymphoid tissue | 1 |
| Some lymphoid tissue | 1 |
| Scanty lymphoid tissue | 3 |
| No lymphoid tissue | 8 |
| Percentage of positive findings | 38.5 |

affect the whole gland but develops in patches within a diffuse colloid goiter, it is easy to recognize that the lymphocytes collect only in or around the cellular hyperplastic islands, and that the colloid rich areas are practically free from round cells. This is certainly not in favor of Warthin's theory that the lymphoid tissue is a manifestation of a constitutional abnormality, because in this case we would expect it evenly distributed over the whole gland, independent of the epithelial hyperplasia. Another proof that the lymphocytic infiltration is due to the proliferation of the acinar cells and to the pathological secretion of the exophthalmic goiter itself, is the influence of iodine treatment on the morphology of hyperplastic goiter. Rienhoff was the first who pointed out that the lymphoid hyperplasia was much less pronounced after iodine administration as compared with cases in which Lugol's solution had not been given. In a recent paper, I reported that in 30 cases of Graves' disease in which iodine was not given, 2 glands were without any groups of lymphocytes, 5 had a few, and 23 had many groups. In 30 other exophthalmic goiters removed after iodine medication, I found

that lymphocytic infiltration was absent in 10 glands, scanty in 7, abundant in 13. This shows that the lymphoid tissue decreases as the hyperplasia and hypersecretion of the thyroid gland is inhibited by iodine.

Warthin's contention that a status thymicolymphaticus is associated always with lymph follicles in the thyroid gland is not substantiated by the observations of Simmonds, v. Werdt, and Wegelin. In our own material there were 2 cases of sudden death, which presented all anatomical signs of a thymicolymphatic constitution, but failed to show any lymphoid tissue in their thyroid glands.

CONCLUSIONS

1. Warthin's and Simpson's theory that in Graves' disease the thyroid gland is not the chief pathogenic factor, but an incidental complication and sequela to a constitutional anomaly, is not confirmed by our study.

2. The most important histological criterion of Graves' disease, as far as the thyroid itself is concerned, is not the presence of hyperplastic lymph follicles throughout this gland.

3. Of our cases of Graves' disease and toxic goiter only 66 per cent had lymphoid tissue in the thyroid gland, and of the cases without clinical symptoms of thyreotoxicosis 38.5 per cent showed lymphocytic infiltration.

4. In our typical cases of status thymicolymphaticus, the thyroid gland was free from lymphocytes.

5. Lymphocytic infiltration of the thyroid is not a manifestation of an underlying constitutional anomaly, but is a purely local response to hyperplasia and hypersecretion of the gland.

6. Our findings are in complete agreement with the theory of Moebius that hypersecretion of the thyroid gland is the essential cause of Graves' disease.

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CORPUS LUTEUM OF PREGNANCY¹

PERSISTENCE OF PREGNANCY AFTER EXCISION OF THE CORPUS LUTEUM IN THE EARLY WEEKS

MARION DOUGLASS, M.D. F.A.C.S. CLEVELAND OHIO

THE function of the corpus luteum of pregnancy in relationship to an existing pregnancy has been the subject of much discussion and theorizing. I wish to report observations made upon three cases in which the corpus luteum of pregnancy was excised. In one of these, the existing pregnancy was not disturbed and persisted approximately to the fifth month. Physiological ablation experiments in the human naturally are not common and instances in the literature of operative removal of the corpus luteum of pregnancy or of its destruction are rare enough to be worthy of consideration. The early work of Beard, Prenant, and Born suggested that the existence of pregnancy in the uterus depended upon the corpus luteum and its secretions. Fraenkel produced abortion in pregnant animals by destroying corpora lutea with a cautery. Loeb showed in guinea pigs that, for the production of traumatic deciduomata, i.e., the sensitization of the uterus, essential for the formation of deciduomata which is itself essentially the reaction of maternal placenta formation, the corpus luteum was necessary. Frank states that the removal of corpus luteum at operation is often followed by premature menstruation, when the pregravid activation of the mucosa has already taken place and that during pregnancy, the corpus luteum inhibits follicular ripening as well as the cyclic engorgement of the genitals which might disturb the developing ovum. He also holds that any foreign body may stimulate the endometrium sensitized by corpus luteum to form the maternal portion of the placenta (Loeb). According to Frank, the corpus luteum of pregnancy is essential to the life of pregnancy at most only in the first 6 weeks. The placenta, i.e., previously fetal trophoblast, presumably elaborates an identical or similar hormone which suffices then for the continued existence of the pregnancy. De Lee disturbed, at laparotomy, corpora lutea of pregnancy, in two cases. He

reimplanted the corpus luteum material in the broad ligaments as free grafts in each case. An abortion occurred at 4 weeks and 1 week, respectively.

We excised the corpus luteum of pregnancy under a variety of circumstances in the following cases:

CASE 1. K. S. white aged 29 years, 11 para. Case No. 18593. Patient entered the Lakeside Hospital June 5, 1928 complaining of intermittent bleeding occurring May 3, 1928 lasting one and one half days and associated with severe pain in the lower abdomen. Three weeks later the pain again became severe and patient was admitted to the hospital after 4 days during which she had passed a few small clots of blood. The last menstrual period began April 8, 1928, previous menstrual period had begun March 15, 1928 and was normal in character. Patient has two children aged 6 and 4 years and had one spontaneous abortion 3 years ago at 3 months. The anamnesis was negative otherwise. Physical examination revealed a well developed and quite well nourished young woman, afebrile, fairly comfortable. The general physical examination was negative. Vaginal examination revealed a marital outlet and the cervix transversely lacerated particularly on the left. It was dilated admitting freely the tip of the index finger and there were large blood clots in the vagina and protruding from the cervix. The uterus was enlarged approximately to the size of a 6 weeks pregnancy, and was quite hard and smooth in outline. The amount of bleeding, the wide dilation of the cervix and the consistency of the uterus made the diagnosis of inevitable abortion seem obvious. On June 6, 1928, the uterus was curetted bluntly. Old black blood clots were removed together with a small piece of placental tissue approximately the size of the end of one's index finger. The uterus had the consistency of involution being quite firm although definitely enlarged. The uterus was swabbed with tincture of iodine and the tip of an iodoform gauze drain was left in the uterine cavity.

Pathological report. The histological sections showed normal placental tissue. Approximately 4 weeks later, July 6, the patient was readmitted to the hospital with the complaint of pain in the right lower quadrant. For 2 weeks she had been bleeding intermittently. On examination the outlet was marital, the cervix hard and firm, the uterus anterior, the size of a small orange and of very firm consistency. There were no lateral palpable masses. It seemed likely the subinvolution and bleeding

¹From the Department of Obstetrics and Gynecology of the Western Reserve University School of Medicine and the Lakeside Hospital.

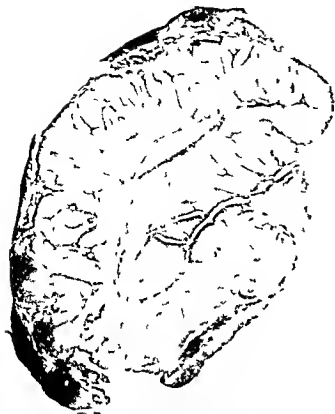


Fig 1 The fairly large corpus luteum of pregnancy which was removed from the left ovary of Case 1. There is characteristic development of lutein cells about the central cavity



Fig 2 A fragment of corpus luteum of pregnancy removed from Case 3. There is the small development of paralutein cells which is characteristic of the first half of pregnancy

might be due to a piece of retained placenta. It failed to occur to me that this patient could have become pregnant again. The patient elected to have tubal sterilization in addition, inasmuch as she was to have a general anæsthetic, and this request was granted.

At operation on July 7, 1928, the uterus was found to be globular and quite firm, the cervix was easily dilated, and a fairly profuse flow of blood followed dilatation. The uterine cavity seemed hollow and empty when a curette was passed into it. Curettings were small in amount. The uterine cavity was swabbed with iodine and a small pack was inserted which was removed in 24 hours. The abdomen was opened through a low midline incision and the uterus was found to be enlarged and slightly softer than normal. The color did not suggest pregnancy, the uterus being normally pale. Resection of the cornual portion of the tubes was done. The uterine cornua were closed and the proximal ends of the distal fragment of tubes were buried in the broad ligaments. The uterine portions of the tubes were completely excised and the uterine musculature closed firmly with interrupted sutures. The patient previously had had an appendectomy. There were no other abnormalities in the abdomen.

There was found a fairly large corpus luteum in the left ovary (Fig 1) which was shelled out gently and the ovarian defect closed with fine interrupted

sutures. The right ovary was normal. The corpus luteum measured about 1 centimeter in diameter. Histologically, the corpus luteum (Fig 4) revealed vascularization and no degenerative changes. Curettings were moderate in amount and showed large decidual cells, some of which were in good condition and some of which showed degeneration with large engorged venous sinuses. Examination a few weeks later showed no reduction in the size of the uterus. In September, a roentgenogram showed the evidence of fetal bones. About September the patient began to pass pinkish, thin fluid from the uterus. This stopped and the uterus increased in size normally until November 17, 1928, when the patient passed a thin serosanguineous pinkish fluid and the following day she began to have labor pains and suddenly ruptured the membranes prolapsing the umbilical cord. The cervix was found to be dilated a finger's breadth and as the fetus was dead she was allowed to continue in labor and was delivered of a dead fetus of approximately 5 months the following evening, the placenta which was normal being expelled spontaneously. Grossly, the fetus was normal. The patient's convalescence was uneventful.

The failure of this pregnancy to be disturbed by chemical and surgical traumata in the form of iodine application and curetting,

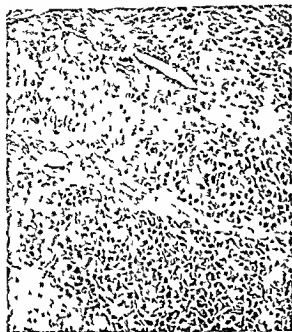


Fig 3 High power view of corpus luteum of pregnancy from Case 2. There is a well marked connective tissue stroma.



Fig 4 The section shows a high power view of corpus luteum of pregnancy near the periphery showing stroma and small groups of paralutein cells. There are visible many of the colloid bodies pathognomonic of corpus luteum of pregnancy (Marcotti).

seems almost impossible although the possibility of this pregnancy being in a rudimentary horn of a bicornuate uterus which would offer it some protection, must be kept in mind. This consideration and the size of the fetus in November seemed to suggest that the corpus luteum was excised when the maximum duration of the pregnancy could not exceed 4 weeks.

CASE 2. L. S. aged 33 years, 11 para. Case No. 115025. This was a patient of Dr. Elliott C. Cutler. She was admitted to the Lakeside Hospital complaining of abdominal distention and obstipation. She was $3\frac{1}{2}$ months pregnant. Physical examination was negative except for a distended abdomen with no tenderness, rigidity or visible peristalsis. Clinical and X-ray studies confirmed the diagnosis of megacolon and cecostomy was planned as a preliminary step. Laparotomy was done with the plan of performing an ileosigmoidostomy. The uterus was soft, injected and appeared to be about 4 months pregnant. Anastomosis was performed between ileum and sigmoid.

There was a rather large, well preserved corpus luteum of the right ovary which was excised, it having been planned previously to terminate the pregnancy at another procedure. One month later the patient, who was making a perfectly normal and satisfactory convalescence and was up and about,

developed distention and following effective catharsis by castor oil, the cecostomy wound began to herniate and became constricted and finally gangrenous. Hyperpyrexia and high leucocytosis 19,000 followed, and the patient at this point developed a show of blood and went into labor with regular pains and miscarried spontaneously. The onset of labor here probably was due to the peritonitis.

CASE 3. H. D., aged 30 years. Case No. 11920. Patient was a white married woman of 30 years complaining of persistent vomiting, hyperemesis gravidarum, amenorrhea and a sensation of prolapse. An unilateral oophorectomy had been done 5 years ago for ovarian cyst and a therapeutic abortion in 1927 for pernicious vomiting of pregnancy. The menstrual periods had been regular the last period occurring February 18, 1929. Sterilization had been recommended for this patient at the time of the therapeutic abortion. On examination, the outlet was found to be rather markedly relaxed, the cervix normal, the uterus anterior, freely movable and apparently normal in size and consistency. There were no lateral masses. On March 14, 1929, a dilatation and curettage was done and a rather thick endometrium was removed. There was nothing to indicate pregnancy. A low midline

incision was made in the abdomen and the pelvis was inspected. The uterus seemed to be very slightly enlarged. There was an early corpus luteum of pregnancy of the left ovary. The right ovary was missing. One centimeter of tube was excised from the cornua on either side and the raw areas peritonized with the round ligament. The corpus luteum was excised (Fig. 2).

Pathological examination. The corpus luteum revealed large, thick zone of lutein cells surrounding a central lumen containing coagulated blood about the periphery. A small zone of the cortical portion of the ovary was seen. Sections of uterine scrapings presented an intact hyperplastic surface epithelium, the glands exhibiting marked hypertrophy and hyperplasia with budding. They were dilated and tortuous. The stroma contained congested vascular channels with areas of early decidua, but no chorionic villi were found. The diagnosis of corpus luteum of pregnancy and uterine pregnancy was made.

SUMMARY AND CONCLUSIONS

Scrutiny of the history of Case 1 suggests the occurrence of preliminary pregnancy beginning after the menstrual period of April 8, 1928. At the beginning of May, bleeding occurred and 3 weeks succeeding, May 29, 1928, the patient had a spontaneous abortion. At that time the uterus was approximately the size of a 6 weeks' pregnancy and on curettage a piece of placenta about 1 by 2 centimeters was recovered. Inasmuch as the uterine cavity was swabbed out with iodine, it seems reasonable to suppose that this pregnancy was definitely interrupted. About 5 weeks later, the patient was readmitted to the hospital complaining of intermittent bleeding for 2 weeks and the uterus was slightly enlarged. The curettings showed large decidual cells. The corpus luteum of pregnancy was excised at this time, which was probably not in excess of 5 weeks' duration. The previous curettage and miscarriage confused the picture somewhat but it seems scarcely reasonable to believe that any pregnancy less than 2 months

would survive the curettage with the removal of a fairly large section of the placenta, the swabbing of the uterus with iodine and subsequent packing with gauze. Here, then, in all probability, we have a pregnancy progressing to its second half without corpus luteum of pregnancy from what may reasonably be assumed to be a duration of about 4 or at most 5 weeks. Essen-Moeller reports a case of bilateral oophorectomy in which it appeared that the corpus luteum may have been excised within the first month of pregnancy. This pregnancy had proceeded to term.

In Case 2 we have the corpus luteum of pregnancy excised at the fourth month. This was followed by an abortion. However, the administration of cathartics and later the presence of peritonitis is more than sufficient cause to induce uterine cramps and abortion so no conclusion can be drawn.

The corpus luteum was removed in Case 3 incidentally for histological examination when the tubal sterilization was performed. This patient had not missed a period but thought she was pregnant, she having developed nausea. The evidence offered by Case 1 allows one to state with some assurance, that in the human, pregnancy is independent of the hormone supplied by the corpus luteum of pregnancy once its duration exceeds approximately 4 to 6 weeks.

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A HORMONE TEST FOR THE DIAGNOSIS OF EARLY PREGNANCY

CLINICAL APPLICATION IN 100 CASES, PRELIMINARY REPORT

P F SCHNEIDER M.D., F.A.C.S., EVANSTON, ILLINOIS

THE diagnosis of early pregnancy, and its differentiation from other pelvic conditions, can at present be accomplished with a considerable degree of accuracy by means of the Aschheim Zondek test. This test is based on the fact, first, that large amounts of the hormone of the anterior pituitary body are excreted in the urine during pregnancy, and, second, that when urine containing this hormone is injected into immature mice, ovulation occurs.

As outlined by Aschheim, the procedure necessitates the use of five or six immature female mice, 3 weeks of age, for each experiment. Varying quantities of urine are injected into each mouse, three times daily, over a period of 2 days. Autopsy is done one hundred hours after the first injection, and the presence of ovulation as demonstrated by the macroscopic and microscopic presence of corpora lutea and corpora hemorrhagica, give positive evidence of pregnancy in the patient from whom the urine was obtained. In a report of one thousand cases, Aschheim demonstrated 98.2 per cent accuracy, and stated that in the cases in which accurate results

were not obtained in the first test, subsequent tests gave results which were later substantiated.

Friedman (3), in his work on ovulation in the rabbit, demonstrated that intravenous injection of 5 cubic centimeters of urine from a pregnant woman provokes ovulation in the same manner as in the mouse, the advantage being that ovulation occurs within 24 hours, either because of the injection of a single large amount directly into the blood stream, or because of the sexual peculiarities of the rabbit. Friedman injected eighteen rabbits with urine from pregnant women and obtained positive results in each instance. Fourteen rabbits, each injected with urine from non pregnant women, all gave negative results. This work increased the value of the test by materially decreasing the time element, simplifying the technique, and apparently maintaining as great a degree of accuracy as that obtained by Aschheim and Zondek.

Friedman's results were so striking that it was decided to use the test in a series of cases in an attempt to determine its clinical value as a practical procedure in the diagnosis and differential diagnosis of early pregnancy.

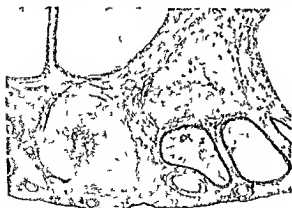
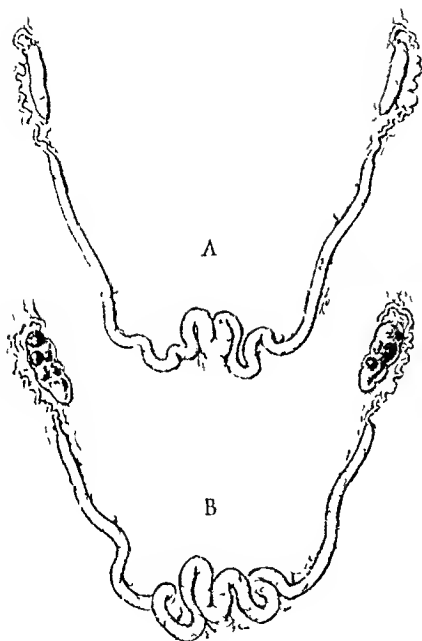


Fig. 1 High power photomicrograph of portion of rabbit ovary after injection of urine from pregnant patient 12 days after opening of tubes by inflation with carbon dioxide showing two well developed corpora lutea $\times 40$



Fig. 2 Low power photomicrograph of rabbit ovary after injection of urine from non pregnant patient showing no corpora lutea or corpora hemorrhagica $\times 25$



A Bicornate uterus, tubes, and ovaries of a 14 week rabbit, 30 hours after injection of 7 cubic centimeters of urine from a non pregnant patient. This demonstrates a negative result, with no changes occurring in the ovaries.

B Bicornate uterus, tubes and ovaries of a 14 week rabbit, 30 hours after injection of 7 cubic centimeters of urine from a pregnant patient. This demonstrates a positive result from an approximate 5 weeks' pregnancy, showing the presence of numerous corpora lutea and corpora hemorrhagica.

*Plate I A Hormone Test for the Diagnosis of Early Pregnancy —
P. I. Schneider*

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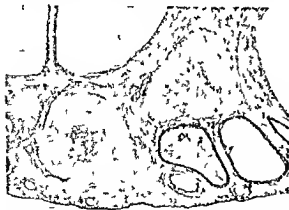


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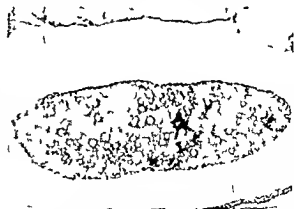


Fig. 2. Low power photomicrograph of rabbit ovary after injection of urine from non pregnant patient, showing no corpora lutea or corpora hemorrhagica. $\times 25$

Enumeration of the factors involved in this test will in a measure explain the technique which has been developed. The rabbit does not as a rule copulate or go into heat until the age of 5 months during the summer, and 6 to 8 months during the winter (Hammond and Marshall). The rabbit has no regular cycle, does not ovulate unless it copulates, and following copulation, ovulation occurs in 8 to 10 hours (Friedman, 4). By using rabbits not over 12 to 14 weeks of age, the possibility of ovulation from other causes than the injection of the hormone is reduced to a minimum. We have found that when rabbits under 3 months of age are used, the results are not constant and are of little value.

It has been demonstrated that the blood stream of many individuals at times contains the hormone of the anterior pituitary body, but that during pregnancy the amount is increased so greatly that it is excreted in the urine. It has been demonstrated that the ovarian hormone also is excreted at times in varying amounts in the urine of women (Loewe and Lange). This follicular hormone (Frank) causes uterine hypertrophy but does not cause ovulation. Animal experimentation with fresh pituitary substance has established the pituitary hormone as the activating factor which is the cause of ovulation in the tests described (Friedman).

The occurrence of ovulation in the rabbit is demonstrated by the macroscopic presence of corpora hemorrhagica and corpora lutea at autopsy and can be further established by microscopic examination. Friedman has found the free ova present in the fallopian tube following this test.

TECHNIQUE IN PRESENT SERIES

The technique requires the use of one female rabbit 12 to 14 weeks of age. A specimen of the first urine voided in the morning is obtained in a clean receptacle. From 5 to 7 cubic centimeters of this urine is injected into the marginal ear vein. Sterile precautions are not necessary in making the intravenous injection. Mortality among the rabbits has been a negligible factor, and can be almost entirely eliminated by using only clear specimens, the urine being filtered if cloudy.

Autopsy is done in from 24 to 30 hours after injection, and an immediate diagnosis is possible by macroscopic inspection of the ovaries. If negative, the ovaries remain small in size and show no change. If positive, from one to fourteen corpora hemorrhagica and corpora lutea are found present in each ovary. In some instances, a positive result has been obtained in 12 hours, and it has become our custom to inject two rabbits in cases in which a diagnosis of pregnancy might influence a decision regarding operation. The first rabbit is then autopsied at 12 hours, and the result can be checked by autopsy on the second rabbit at 24 or 30 hours without loss of time.

TYPES OF CASES STUDIED

We have used the test in a series of one hundred cases which are divided into three groups: (1) 25 positive control cases in which a diagnosis of pregnancy was previously established by other means, (2) 25 negative control cases in which it was definitely known that there could be no pregnancy present, and (3) 50 test cases in which pregnancy was suspected but could not be diagnosed.

Positive control cases. The approximate stage of the pregnancies in the 25 positive control cases was

| | Cases |
|-----------|-------|
| 3d month | 5 |
| 4th month | 1 |
| 5th month | 4 |
| 6th month | 1 |
| 7th month | 5 |
| 8th month | 4 |
| Term | 5 |

In each of these a positive result was obtained and the diagnosis of pregnancy checked by subsequent clinical findings.

Negative control cases. The 25 negative control cases were

| | Cases |
|-------------------------------------|-------|
| Normal | 2 |
| Male | 3 |
| Menopause | 3 |
| Complete ovariectomy | 1 |
| Complete ovariectomy with carcinoma | 1 |
| Postpartum | 15 |

In this series of non-pregnant cases, all results were negative with the exception of 5 in the postpartum series. The postpartum cases were tested to determine how long the positive reaction persists after delivery.

Postpartum cases In the 15 postpartum cases, the urine, obtained at varying intervals after delivery, was tested with the following results

| Cases | Interval postpartum | Result |
|-------|---------------------|----------|
| 1 | 12 hours | positive |
| 2 | 18 hours | positive |
| 2 | 24 hours | positive |
| 1 | 24 hours | negative |
| 1 | 26 hours | negative |
| 1 | 41 hours | positive |
| 1 | 67 hours | positive |
| 2 | 4th day | negative |
| 2 | 7th day | negative |
| 2 | 10th day | negative |

It is seen that the reaction disappears very rapidly following delivery, and that it was found absent in one instance 24 hours, and in another 26 hours after delivery. In two other cases a positive reaction was obtained 41 and 67 hours post delivery.

Test cases In this series of cases, in which pregnancy was suspected but could not be diagnosed, 20 gave positive results by the test and in each instance were confirmed by subsequent events. The 30 others gave negative results and, in all except two instances, subsequent events proved the test to be correct. In these two instances negative results were obtained at first, but later tests proved positive. These inaccuracies occurred when, for the first time, 6 week rabbits were used. Subsequent tests with 12 week rabbits gave positive results which later were proved to be correct. This demonstrated that it is impossible to obtain accurate results if the rabbits are not sufficiently mature.

ABBREVIATED REPORTS OF ILLUSTRATIVE CASES

CASE 6 Mrs M. The tubes were found closed February 13 by tubal inflation with no penetration of carbon dioxide. Inflation was repeated February 20 and after using pressure up to 210 millimeters, the mercury column suddenly dropped with entrance of gas into the peritoneal cavity. Twelve days following the last tubal inflation 6 cubic centimeters of urine injected into a rabbit yielded a positive result in 24 hours. The accompanying photomicrograph (Fig 2) of the ovary of the test rabbit shows the presence of the corpora lutea and corpora hemorrhagica and subsequent events demonstrated the presence of a normal pregnancy in the patient.

CASE 49 Mrs H. Last pregnancy terminated February 17, 1930. Normal menstrual periods recurred April 8 and May 12. On June 9 patient gave a history of being nauseated by cigarette smoke, a symptom which was present early in the previous pregnancy. Menses were due June 12 to 16. Test from specimen obtained June 10 gave a positive result. Menses had not occurred July 1.

CASE 50 Mrs T, aged 38 years. Patient had had one criminal abortion 10 years ago and had subsequently been sterile. Inflation of tubes March 6, 1930 showed obstruction with apparent failure of gas to pass through the tubes. Inflation was repeated March 13, 1930 with apparently negative results. Last menstrual period was May 3. On May 29 iodized oil was injected into the uterus and the X ray showed the tubes to be patent, the oil passing into the peritoneal cavity. The menstrual period which should have occurred May 31 did not appear, and a test from specimen obtained June 5 gave a negative result. Patient stated that if pregnancy were present, it must have occurred prior to May 29, and probable date was May 21 or May 26. The test was repeated with a specimen obtained June 10 and gave a strong positive reaction.

CASE 4 Mrs J, iv para. The menses which were always regular, of 30 day type, had been delayed 3 days. Previous menstrual period was normal. A third degree retroversion was present. Five cubic centimeters of urine was injected into a rabbit. The test gave a positive result. Subsequent events demonstrated the presence of a normal pregnancy.

CASE 5 Mrs S, ii para. Patient gave a history of incomplete abortion with constant bleeding from December 10 to January 9. No subsequent menstrual periods occurred in February. She had a third degree retroversion. Seven cubic centimeters of urine were injected into a rabbit February 13 and gave a positive result. Examination at a later date verified the diagnosis of pregnancy.

CASE 10 Mrs P, iv para. No menstrual period had occurred since termination of last pregnancy, September 1929. February 3, 1930 examination revealed the uterus slightly increased in size. Seven cubic centimeters of urine injected into a rabbit gave a positive result. There have been no subsequent menses and examination on July 3 revealed a 6 months pregnancy.

CASE 15 Mrs S, ii para. Menses had been delayed 10 days. Test positive. Two weeks later patient was sent to hospital with severe uterine bleeding. Test was repeated 2 weeks following cessation of bleeding and gave negative result. Regular menses have appeared.

CASE 28 Mrs D. Patient gave a history of irregular menses. Last menstrual period was January 9. March 22 physical examination revealed no definite evidence of pregnancy. Test at this time gave positive result. Two weeks later patient was admitted to hospital with intestinal obstruction. Immediate operation followed, with separation of

bands of adhesions about the hepatic flexure of the colon. Caecostomy was done. Inspection of uterus revealed the presence of a 2 months' pregnancy and right ovarian cyst, which was removed at this time. Two weeks following operation the test was repeated to determine if it would give any information as to whether the fetus was alive or dead, as patient had had nothing by mouth, and fluids intravenously and subcutaneously only, since operation. Prior to the time of obtaining specimen, there had been no vaginal bleeding, and no evidence that death of fetus had occurred. The test gave a positive result. Forty-eight hours later patient began having uterine contractions and expelled a macerated fetus of from 2 to 2½ months.

CASE 38 Mrs. M. A cystic ovary had been removed 4 years ago. Menses have been regular since that time. She has had amenorrhoea for past 2 months. Examination revealed a third degree retroversion and the presence of a mass which was suspected of being a cystic ovary. Test at this time gave positive result. Forty-eight hours later, patient began having active uterine bleeding and evacuation of the contents of the uterus revealed a 2 months' pregnancy. A laparotomy showed a large cystic ovary.

CASE 8 Mrs. N. Menses have always been regular. Present menstrual period was delayed 3 days. Test was negative. A normal menstrual period occurred several days later.

CASE 23 Mrs. H. Menses have been irregular. Amenorrhoea had been present for past 2 months. Basal metabolism test indicated the presence of hypothyroidism. Test was negative.

CASE 26 Mrs. E. Last previous pregnancy had been terminated 3 months ago. No menstrual periods had occurred since that time. Pelvic examination revealed a mass in the pelvis the size and consistency of a 2 months' pregnancy. Test was negative. Abdominal operation revealed the presence of a right interligamentous cyst.

CASE 20 Mrs. S. Last pregnancy was terminated in November, 1929. April 12, 1930, there had been no return of the menstrual period. Test was negative. Normal menstrual period occurred May 1, 1930.

CASE 35 Mrs. C. Last pregnancy terminated January, 1930. Patient had had 13 pregnancies during the past 12 years, with only four living children. This condition was accompanied by a chronic nephritis, and sterilization had been advised. A test was carried out to establish definitely the absence of pregnancy prior to operation. A negative result was obtained.

CASE 36 Miss A. Patient gave a history of irregular menstruation. Amenorrhoea had been present for 2 months. Test was carried out to exclude pregnancy as cause of amenorrhoea. Test was negative. Normal menses occurred several weeks later.

CASE 37 Mrs. M. Previous pregnancy was terminated in December. Menses recurred in April.

In May the patient presented herself, with a history of the menses being 7 days overdue. The test was negative.

RESULTS OF STUDY

In the 25 positive control cases in which previous diagnosis of pregnancy was possible, a positive result was obtained by the hormone test in each instance, while in the negative control cases, 25 specimens from non-pregnant patients all gave negative results except as explained previously. This is of significance because it demonstrates that urine from normal non-pregnant women, males, women following menopause, artificial menopause as a result of ovariectomy, or carcinoma, does not give a positive result when tested by the method described. Fluhman, using blood serum instead of urine, obtained positive results in mice in conditions other than pregnancy, as menopause, artificial menopause, functional amenorrhoea and irregular menstruation. It is known that carcinoma, menopause, and ovariectomy cause a hypertrophy of the pituitary gland, but according to the results reported by Aschheim and Zondek in their work with mice, and the small number of such cases in this series, there is no evidence that the resulting hypertrophy and excretion of the hormone is sufficient to cause a positive result when the urine is used for the test.

The negative control series also brings out the rather significant fact that the hormone quickly disappears from the urine after delivery. The question arises as to whether, in the two cases in which it was positive at 41 and 67 hours after delivery, this delayed disappearance of the reaction was due to retained fragments of placental tissue. Aschheim and Zondek report positive results for their test in only two conditions other than pregnancy, hydatidiform mole, and chorio epithelioma. We have not had either of these conditions available for the present series, but the indications are that the reaction is caused by the presence of embryonic tissue in contact with the maternal tissues, and that it continues as long as this contact is maintained.

The series of test cases from which the case reports have been selected shows that the test is positive very early in the pregnancy, but it has been rather difficult to ascertain how

promptly after the particular intercourse responsible for the pregnancy a positive reaction may be obtained. The suggestion of an answer to this question was obtained in the first 3 cases reported.

In Case 6, it seems likely that the pregnancy occurred following the last tubal inflation, or at the very earliest, following the first inflation, which indicates that a positive result was obtained from 12 to 20 days following the first intercourse at which pregnancy was possible.

In Case 49, a positive result was obtained within 2 to 4 days prior to the date at which the normal menstrual period was expected, the last menstrual period having been normal.

In Case 50, it is likely that the pregnancy occurred as a result of coitus on May 21 or 26, which would mean that a positive test was obtained in approximately 20 days. In this case, the negative result obtained 5 days earlier may be interpreted as indicating the approximate time after which the reaction becomes positive.

This interpretation in the three instances mentioned, leads us to assume that the hormone of the anterior pituitary appears in the urine in sufficient quantity to give a positive test as early as 12 to 20 days following the coitus which is responsible for the pregnancy. Further investigation is necessary to establish this point definitely.

Of equal importance to the positive results obtained in early pregnancy are the negative results in instances of menstrual irregularity in non pregnant women, demonstrated by amenorrhoea of a duration of from several days to several months. The application of the test where menses have not recurred following a recent pregnancy, and where other symptoms or findings lead to a suspicion of another pregnancy, has given definite results both positive and negative, which have been substantiated in each instance by subsequent events.

SUMMARY AND CONCLUSION

The small series of cases here presented is inadequate for the purpose of drawing definite conclusions, but may serve as a basis for future work in determining the limitations

of the test. Emphasis of the following points seems justified.

1 The simplicity and accuracy of the test indicate that it has a practical value as a diagnostic measure, which is greatly enhanced by the fact that the entire procedure can be completed within 24 hours.

2 Experience with this series of cases indicates that future refinement of the technique will make it possible to decrease the time necessary for the completion of the test to 8 to 12 hours.

3 Application of the test has shown its value effectively in the immediate differentiation of early pregnancy from such conditions as menstrual irregularity due to other causes, delayed return of menses following pregnancy, and pelvic masses simulating pregnancy. Formerly this differentiation required days or sometimes weeks.

4 Application of the test in excluding early pregnancy prior to uterine instrumentation, as in tubal inflation, injection of iodized oil, or pelvic operative work and abdominal surgery or therapeutic use of radium or X ray should eliminate many of the unfortunate experiences which occur.

5 The rapid disappearance of the hormone after delivery, and the persistence of the reaction following incomplete abortion or death of the fetus, indicate that future investigation may prove the test of value in the diagnosis of retained decidua tissue following labor or incomplete abortion.

6 The question of the diagnosis of ectopic pregnancy, hydatidiform mole, and chorion epithelioma has not been encountered in this series, but provides considerable latitude for future investigation.

I wish to acknowledge the assistance rendered by Dr W. W. Brandes of the department of pathology of North western University in the pathological work which was done to confirm the gross findings of the test.

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THE CAUSE OF DEATH IN LIVER AUTOLYSIS

EDMUND ANDREWS, B A, M D, F A C S, AND LEO HRDINA¹, CHICAGO

IN 1924 our attention was called by the studies of Mason to the extreme toxic reaction produced by implanting pieces of fresh liver in the peritoneal cavity of dogs. One of us extended these observations to other regions of the body showing that similar toxicity was produced if the transplanted liver was introduced into the pleura or subcutaneously. Ellis and Dragstedt more recently have shown that these results were due to the fact that a severe peritonitis was set up due to a bacillus similar to the bacillus welchii organism. In their experiments they show that pieces of autoclaved liver inserted into a dog's abdomen failed to cause peritonitis and also pieces of sterile liver obtained from fetal dogs similarly were non-toxic. The results were therefore attributed to infection arising from bacteria lying latent in the liver. In their review of the literature on the subject they showed that the presence of organisms in the tissues had been recognized for many years and that one observer, Wolbach, had even reported a special anaerobe in dogs' livers.

Our experiments were begun to analyze the mechanism of this peritonitis. The deaths in all the reported series of both ours and those of Mason and Dragstedt were all so prompt (generally within 20 hours) that it seemed inconceivable that a pure infection could be responsible for them. One cannot think of any parallel of the case in which such a small number of organisms introduced intraperitoneally will produce death in from 12 to 18 hours. This is of special significance when one considers the well known immunity of the dog's peritoneum to extraneously introduced infection of any sort. The experimental production of peritonitis has proved in the hands of all observers to be a very difficult matter. Even the complete transection of the bowel will not in most cases produce such a toxic reaction or prompt death. With these points in view, the following sets of experiments were undertaken.

EXPERIMENTS

Group I Two dogs were killed by electrocution. Their livers were removed under aseptic precautions, were cut up and ground with sand in a sterile mortar. The specimens were divided into 100 gram lots and 3 were incubated for 24 hours and 1 for 28 hours. They were then removed from the incubator and autoclaved for 40 minutes under a pressure of 17 pounds. In each case, cultures taken proved them to be sterile after the autoclaving. The 100 gram specimens were then introduced into abdomens of 4 normal dogs and in each case there was prompt death of the animal within 16 hours. Cultures of the peritoneum and transplanted ground liver showed in every case enormous numbers of organisms resembling the bacillus welchii.

The pathological and bacteriological pictures found in the entire series reported in this paper were very much the same and will be described at this point. The organisms were gram positive rods of large size and with thick capsules. Contrary to the experience of Dragstedt and Ellis they caused a strong fermentation of milk in a very high percentage of cases. Of about 100 cultures made there was destructive fermentation of milk with acid formation in all except three strains encountered. This would take place within a 16 to 18 hour period. In the 3 there was a souring of the milk and an acid clot formation. While no further studies have been made as to the bacteriological identification of this organism, we feel justified in assuming that it is simply a strain of bacillus welchii, and it will be referred to as such during the remainder of the paper.

The pathological pictures encountered have also presented a striking similarity. In the vast majority of cases when the intraperitoneal injections or implantations were made in the afternoon, the animal was found dead and cold at 8 o'clock in the morning. In a few cases in which the injections were made in the morning, death occurred before 6 p.m. and occasionally as early as 2 to 3 hours after injection. The findings are all quite typical and are not in the least those of aseptic

¹From the Department of Surgery of the University of Chicago.

TABLE I—EFFECT OF PLACING GROUND AUTOLYZED STERILE LIVER INTO THE PERITONEUM

| No | Material implanted | Culture of implant | Survival hrs | Culture of peritoneum at autopsy | Postmortem |
|----|-------------------------------------------------------------------------------------------------------------|--------------------|--------------|----------------------------------|-----------------------|
| 10 | 100 gm. of liver from electrocuted dog removed and ground aseptically and incubated 48 hours and autoclaved | Sterile | Less than 18 | B. welchii | Autolytic peritonitis |
| 11 | Same with 24 hour incubation | Sterile | Less than 18 | B. welchii | Autolytic peritonitis |
| 12 | Same as No. 11 | Sterile | Less than 24 | B. welchii | Autolytic peritonitis |
| 13 | Same as No. 12 | Sterile | Less than 16 | B. welchii | Autolytic peritonitis |

TABLE II—EFFECT OF PLACING FRESH GROUND STERILE LIVER IN PERITONEUM

| No | Material implanted | Culture of implant | Survival hrs | Culture of peritoneum at autopsy | Postmortem |
|----|----------------------------------------------------------------------------------|--------------------|----------------|----------------------------------|-----------------------------------------------------------------|
| 22 | 100 gm. of liver from electrocuted dog removed ground aseptically and autoclaved | Sterile | 72 | Not made | Not typical picture of autolytic peritonitis purulent infection |
| 23 | Same | Sterile | 40 | B. welchii | Autolytic peritonitis |
| 24 | Same | Sterile | Killed 17 days | 0 | Material scattered and about half absorbed |
| 25 | Same | Sterile | Less than 24 | B. welchii | Autolytic peritonitis |
| 26 | Same | Sterile | Less than 18 | B. welchii | Autolytic peritonitis |
| 27 | Same | Sterile | Less than 24 | B. welchii | Autolytic peritonitis |

peritonitis. The abdomen is generally enormously distended with gas if the animal lives more than 12 hours. Upon opening it, there is discovered a large amount of exudate measuring between 300 to 500 cubic centimeters. This exudate contains froth on its surface and bubbles are to be found on the under surface of the liver and the other viscera. It is blood stained and bright red in color. There is generally a comparative absence of deposits of fibrin and in no case have we encountered any frank pus. The entire peritoneal surfaces are intensely inflamed and in most cases there can be seen exceedingly numerous punctate hemorrhages. These hemorrhages are not necessarily confined to the peritoneum but occur in the other endothelial surfaces of the body, especially the pleura. There is generally engorgement of the lung and microscopic section showing capillary hemorrhages in the lung as well. The most striking changes occur, however, in the host's liver. The livers are infiltrated with gas and exceedingly friable and feel greasy to the touch. Microscopic examination reveals an exceedingly advanced stage of liver degeneration with necrotic areas scattered through the tissues and granular cytoplasm about the portal channels, with a

minimal infiltration of leucocytes. In other words, we have a picture of a severe toxic reaction and not of a severe infection.

In the series of rabbits, to be reported, the condition was even more striking. Grossly, it was almost impossible to distinguish between the appearance of the transplanted liver and the host's liver. Both showed almost equally severe autolytic changes. On microscopic examination, while the transplanted liver showed more advanced necrosis the host's liver showed such changes that one could not be sure without reading the labels on the slides which was which. This description will serve for the pathology of all the rest of our report and the picture will henceforth be spoken of as "autolytic peritonitis."

It is evident from these experiments that the livers which have been allowed to autolyze and are then sterilized contain substances which are capable of bringing about this condition of autolytic peritonitis, even in the absence of the bacillus welchii.

Group II. In this set of experiments normal dogs were electrocuted and 100 gram specimens of their livers taken which were ground and immediately autoclaved (see Table II). They were cultured and shown to be sterile. They were then implanted in

TABLE III—EFFECT OF VARIOUS FACTORS ON VIRULENCE OF AUTOLYTIC PERITONITIS

| No | Material implanted | Culture of implant | Survival hrs | Culture of peritoneum at autopsy | Postmortem |
|----------|---------------------------------------------------------------------------------|--------------------|---------------|----------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------|
| 46 | 100 gm fresh ground liver from 14 day bile fistula dog | Sterile | Less than 16 | B welchii | Autolytic peritonitis |
| 47 | 100 gm fresh ground liver from 3 months jaundiced dog | B welchii | 8-10 | B welchii | Autolytic peritonitis |
| Rabbit 1 | 25 gm solid piece of fresh aseptically removed rabbit liver into upper abdomen | | Less than 16 | B welchii | Marked autolysis of both transplanted and host's liver. No fluid or hemorrhage in abdomen. Fluid in chest, lungs congested. |
| Rabbit 2 | Same | | 8-9 | B welchii | Same |
| Rabbit 3 | Same | | 8-9 | B welchii | Same. Host's liver incubated 24 hrs and was riddled with gas. |
| Rabbit 4 | Same | | 8-9 | B welchii | Same |
| Rabbit 5 | Same. Same fluid in abdomen | | Killed 10 hrs | B welchii therefore not a postmortem invader | Same but some fluid in abdomen. Pregnant. |
| Rabbit 6 | Same | | Less than 16 | B welchii | Same but no fluid in chest |
| Dog 4 | 18 c cm (2 tubes) of 18 hour milk culture from dog 1 liver. Stormy fermentation | B welchii | 6 days killed | o | Showed no reaction |

TABLE IV—EFFECT OF INTRAPERITONEAL INJECTION OF CONCENTRATED STERILE EXTRACT OF AUTOLYZED LIVERS

| No | Material injected | Culture of material | Survival hrs | Culture of peritoneum at autopsy | Postmortem |
|----|----------------------------------------------------------------------------------------------------------------------------|---------------------|--------------|----------------------------------|-----------------------|
| 25 | 100 gm ground liver incubated 24 hrs. Boiled 2 hrs in 1,000 c cm water, filtered twice and filtrate boiled down to 25 c cm | Sterile | Less than 16 | B welchii | Autolytic peritonitis |
| 26 | Same | Sterile | About 12 | B welchii | Autolytic peritonitis |
| 28 | Same concentrated to 35 c cm | Sterile | 8 | B welchii | Autolytic peritonitis |
| 29 | Same as No 25 | Sterile | 8 | B welchii | Autolytic peritonitis |
| 5 | 40 gm ground liver incubated 24 hrs. Boiled 2 hrs in 1,000 c cm normal salt solution filtered and boiled down to 35 c cm | Sterile | 7-10 | B welchii | Autolytic peritonitis |

the upper abdomen through a small buttonhole incision in the midline. Four of the 6 dogs succumbed to an autolytic peritonitis of exactly the same sort as described in Group I. This peritonitis was a little longer in coming on but otherwise presented exactly the same features and in every case large numbers of bacillus welchii were encountered.

It is obvious, therefore, that both in autolyzed and fresh livers, there resides some toxic factor which renders the infection of the implanted material with bacillus welchii a practical certainty. In each case, in both groups of experiments and in many of the subsequent ones, our cultures were watched for a week or more and in no case was there a development of the growth in time such as

one might expect from any lurking spores. It is well known of course, as was stated by Ellis and Dragstedt in their paper, that both the bowel and normal tissues contain numbers of bacteria especially of this type. But we have here a mechanism in which by some toxic feature there is a great change in the permeability of the bowel so that they are allowed to pass exceedingly rapidly through the bowel wall and to infect sterile material lying in the peritoneum so as to cause an exceedingly rapid production of a toxæmia of overwhelming virulence.

The seeming variance with these results and those reported by Ellis and Dragstedt is

TABLE V—EFFECT OF INTRAPERITONEAL INJECTION OF STERILE DILUTE EXTRACT OF AUTOLYZED LIVER

| No | Material injected | Culture of material | Survival | Culture of peritoneum at autopsy | Postmortem |
|----|------------------------------------------------------------------------------------------------------------------------------|---------------------|----------------|----------------------------------|-------------------|
| 15 | 200 gm. ground liver incubated 24 hrs. extracted 2 hrs. in 1,000 c.c.m. boiling water filtered and boiled down to 400 c.c.m. | Sterile | Killed 24 days | Not made | Normal |
| 16 | 200 gm. ground liver incubated 24 hrs. extracted 2 hours in 1,000 c.c.m. boiling water filtered and boiled to 100 c.c.m. | Sterile | 24 days | Not made | Died of distemper |
| 17 | Same as 16 | Sterile | 24 days | Not made | Normal |
| 20 | Same as 16 but boiled to 235 c.c.m. | Sterile | Killed 5 days | Sterile | Normal |

TABLE VI—EFFECT OF INTRAPERITONEAL IMPLANTATION OF PARTIALLY PURIFIED PROTEIN COAGULUM FROM AUTOLYZED LIVERS

| No | Material implanted | Culture of implanted material | Survival hrs. | Culture of peritoneum at autopsy | Postmortem |
|----|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------|---------------|----------------------------------|------------------------|
| 34 | 100 gm. fresh ground liver autoclaved and extracted 8 hrs. in 4 liters hot water filtered and precipitate implanted | Sterile | 72 | B. welchii | Autolytic peritonitis |
| 30 | Same | Sterile | Less than 18 | B. welchii | Autolytic peritonitis. |
| 32 | Same | Sterile | Less than 18 | B. welchii | Autolytic peritonitis. |
| 27 | 100 gm. ground liver incubated 24 hrs. Extracted three times each with 500 c.c.m. boiling water boiling alcohol boiling ether and alcohol and boiling CHCl ₃ . Remainder dried in water bath emulsified with 25 c.c.m. water | Sterile | Less than 20 | B. welchii | Autolytic peritonitis |
| 28 | Same | | 25 | B. welchii | Autolytic peritonitis. |

probably due to the fact that while in our experiments the liver was finely ground, in theirs it was implanted in a single large piece. This lump of cooked liver is very hard and does not present anywhere near the surface to expose itself to autolysis as is the case when the liver is ground. The same factor will probably act in the fetal livers in which they reported no disturbance.

Group III. A biliary fistula was established in the normal dog by suture of the bladder to skin in the abdominal wall and the bile was allowed to drain for 14 days. During all this period the animal had arid stools. He was rapidly losing weight. He was sacrificed and an autoclaved ground 100 gram specimen of his liver placed within the abdomen of a normal dog. Death resulted in less than 24 hours—the usual picture of autolytic peritonitis.

As a complement to the above experiment, the ground sterilized liver from a dog who had been jaundiced about 3 months was also transplanted into a normal animal and the same picture produced. It was assumed,

therefore, that the bile itself or its constituents were probably not vital factors in the process. With this point in view, the Pettenkoffer reacting material in 100 grams of autolyzed liver was determined through the kindness of Dr. Rewbridge, and values of about 0.06 of a gram of bile salts were found. In view of the fact that there certainly were other substances of a Pettenkoffer reacting type in this material in addition to the bile salts, it is quite obvious that this falls far below the lethal dose as was reported by Rewbridge in his work on bile peritonitis. According to his experiments, it took about 25 grams of bile salt preparation to produce peritonitis.

The influence of diet was then studied by using herbivorous animals and the liver of one rabbit was planted into 5 other rabbits and exactly the same clinical picture of autolytic peritonitis was produced.

In spite of the well known immunity of the peritoneum to bacterial infection, it was

TABLE VII—EFFECT OF INTRAPERITONEAL INJECTIONS OF HYDROLIZED EXTRACTS OF AUTOLYZED LIVER

| No | Material injected | Culture of material | Survival | Culture of peritoneum at autopsy | Postmortem |
|----|----------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------|----------------|----------------------------------|------------|
| 36 | 100 gm liver ground incubated 24 hrs extracted with 4 000 c cm material (boiled 2 hrs) extract boiled 1 hr with few drops 25 per cent KOH and boiled down to 50 c cm | Sterile | Killed 7 days | | Normal |
| 37 | Same | Sterile | Killed 7 days | | Normal |
| 40 | Same | Sterile | Killed 14 days | | Normal |
| 41 | Same | Sterile | Killed 12 days | Sterile | Normal |

TABLE VIII—EFFECT OF INTRAPERITONEAL INJECTION OF DIALYSATES AND CHLOROFORM PRECIPITATES OF AUTOLYZED LIVER

| No | Material injected | Culture of dialysate | Survival hrs | Culture of peritoneum at necropsy | Postmortem |
|----|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------|--------------|-----------------------------------|-----------------------|
| 38 | 100 gm ground liver incubated 24 hrs 200 c cm water added and dialyzed for 3 days against 16 000 c cm water. Dialysate boiled down to 25 c cm | Sterile | About 12 | B welchii | Autolytic peritonitis |
| 39 | Same but 8 000 c cm water used and dialyzed 2 days | Sterile | Survived | | |
| 4 | 12 gm liver dialyzed 3 days | Sterile | Survived | | |
| 41 | 100 gm ground autolyzed liver extracted with 500 c cm boiling water for 6 hrs filtered and filtrate treated with CHCl ₃ in separatory funnel. Precipitates dried and mixed with 25 c cm water and injected | Sterile | 18 | B welchii | Autolytic peritonitis |

thought that this special strain of bacillus welchii might have a specific virulence, and therefore the following experiment was made. A total of 30 cubic centimeters made up of two mixed litmus milk cultures of bacillus welchii recovered from the peritoneum of a dog were injected intraperitoneally into a normal animal. In spite of the overwhelming nature of this dose in the way of bacteria content, the dog showed absolutely no reaction and was sacrificed 4 days later and the peritoneum found to be sterile.

Group IV. The following attempts were made to determine which factor was in the liver which was capable of bringing about autolytic peritonitis when administered to animals intraperitoneally. Five 100 gram specimens of freshly removed liver were ground, mixed with a small amount of water, and incubated for 24 hours. In each case there was marked gas production and strong putrid odors. The material then was dumped into large flasks and extracted repeatedly with boiling water in amounts up to 5,000 cubic centimeters. This extract was then filtered and the filtrate concentrated by boiling to 25 to 30 cubic centimeters and injected into

normal dogs. In each case there was the prompt production of autolytic peritonitis and death.

Group V. An exactly similar set of experiments to Group IV was done, the only difference being that the filtrate instead of being concentrated, was boiled down only to 150 to 250 cubic centimeters. The injection of these filtrates in dilute form into normal animals produced no symptoms whatsoever.

It is clear, therefore, that the toxic factor is a water soluble substance which was thermostable as the material was boiled for a great many hours in the process of concentration as well as the fact that in Groups I and II, material had been autoclaved.

Group VI. Three 100 gram specimens of autoclaved autolyzed livers were extracted for 8 hours in large amounts of boiling water, the water being frequently changed until finally it appeared to contain no more solid material. The left over protein cooked coagulum was then implanted into the abdomens of 3 normal dogs. In each case it produced the typical picture of autolytic peritonitis although one dog lived for 72 hours.

In the next subdivision of this group the same process was followed out except that the

coagulum was further extracted by prolonged boiling with 500 cubic centimeters of alcohol and ether for three changes and then again for three changes of boiling chloroform. This coagulum, after being freed from chloroform by drying, also had the property of producing autolytic peritonitis.

In the latter case it is obvious that the coagulum represents practically pure coagulated protein and that all the lipid material had been dissolved out by the alcohol and chloroform extractions. Thus the lipoids are removed from consideration as the offending agents. Furthermore it is evident that the practically pure protein left over is able on undergoing autolysis to give rise to toxic products which can in turn produce the autolytic peritonitis. With these points in view it was considered probable that the toxic factor must be a split protein product probably a proteose or peptone as there is no other substance known to be present and as none of the amino acids would be capable of doing this. This view is further confirmed by experiments in Group VII.

Group VII. Watery extracts of autolyzed livers were made as in Groups IV and V. A study of these extracts showed that they contained large amounts of a nitrogenous material which gave a strong Biuret reaction of the violet type such as is given by substances of the proteose group. There could be no proteins present because the material had been boiled for hours. When boiled with very weak alkali they no longer gave the proteose type of biuret reaction but the bright red color characteristic of peptones. These extracts (see Table VII) in which all the proteose has been autolyzed to peptones or at least lower nitrogenous substances are no longer toxic.

Group VIII. Watery extracts as prepared above may be freed from their biuret reacting substances by the addition of strong acids or by precipitation with chloroform and partially by precipitation with alcohol, this being a further proof that these sub-

stances belong in the peptone proteose group. Material from 100 grams of autolyzed liver was boiled down to a few hundred cubic centimeters and treated with chloroform repeatedly, the precipitate each time being drained out in a separatory funnel. This treatment was continued until no further precipitate occurred on the addition of chloroform. The precipitated material was then freed from chloroform on a water bath and redissolved in a small amount of water. It was shown to be capable of producing autolytic peritonitis.

Other specimens of watery extract were dialyzed against distilled water for varying periods of time and as can be seen (Table VIII) the toxic material is dialyzable only with great difficulty as it was fatal in only 1 case.

CONCLUSIONS

1. In *in vivo* autolysis of the liver, death is due to a condition described as autolytic peritonitis. That is a toxic reaction characterized by hemorrhages into the peritoneum with production of much fluid and overwhelming infection with gas bacilli.

2. This reaction can be provoked by the implantation of sterile material.

3. The toxic agent is a water soluble thermostable one which is precipitable by alcohol or chloroform, gives a purple Biuret test, and is with difficulty dialyzable and therefore probably falls within the albumose group.

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CLINICAL SURGERY

FROM THE SURGICAL DEPARTMENT, UNIVERSITY OF PARIS

THE JUXTORETROPERONEAL ROUTE IN THE OPERATIVE TREATMENT OF FRACTURE OF THE MALLEOLUS WITH POSTERIOR MARGINAL FRAGMENT

JEAN GATELLIER, PARIS, FRANCE

Assistant Professor of the Faculty of Medicine of Paris and Surgeon in Hospitals of Paris

IN spite of perfection in the technique of reduction in bimalleolar fracture and in spite of the help of roentgen observation in reduction under screen examination, there is a type of malleolar fracture with posterior marginal involvement in which it is impossible to bring about perfect reduction and to maintain reduction once it is accomplished. In these cases operation is necessary and our problem is to determine what is the best incision through which more easily to reach the posterior marginal fragment and fix it.

Dr Chastang, chief of the surgical service of the Faculty, and I have studied this question in the service of our chief, Professor Pierre Duval.

In France two methods have been proposed that of Picot¹ who uses the transachilleal route after an L-shaped skin flap with the attachment on the inner side is made, and that of Algave² who uses the transcalcaneal approach after an L-shaped skin flap attached along the inner border

is made. The second method seems to us to be the best, as it gives a better view and makes use of bone section, which is easier to repair than tendon section. Both of these methods have given very excellent results. They have disadvantages, however, in that they necessitate making bone or tendon section and what is even more serious they necessitate cutting a skin flap in a region that is very poorly vascularized, and this procedure may cause gangrene.

Because of these disadvantages we were led to look for some other line of approach that would be less complicated, and we began using the juxta retroperoneal³ route which afforded access to the three bones on which it might be necessary to operate: the malleolus lateralis, the posterior marginal fragment, and the malleolus medialis.

³Gatellier and Chastang. *J de chir* 1924 xxiv, 513.

¹Picot. *J de chir* 1923 xxi, No 5.

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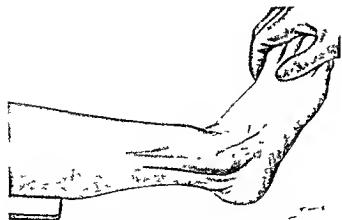


Fig 1 Position for operation. Note the classical deformity caused by the fracture. Juxta-retroperoneal incision traced.

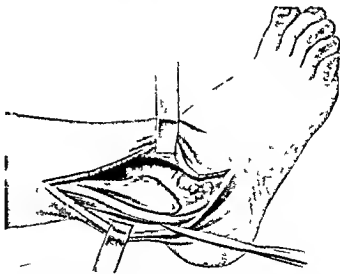


Fig 2 Separation of the two lips of the incision. Opening of the peroneal tendons.

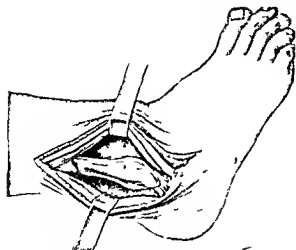


Fig. 3 Pulling the peroneal tendons forward. The fracture of the fibula can be seen.

TECHNIQUE

The patient is placed in dorsal decubitus with the fractured limb extending some distance beyond the end of the table. Two assistants are necessary: one holds the foot and lower part of the leg and is ready to make any manipulation requested by the operator. We will discuss the treatment of the most complicated type of this fracture—fracture of the fibula between 7 and 12 centimeters from the tip, posterior marginal fracture, fracture of the malleolus of the tibia, separation of the tibia and fibula. The operation is performed through an external incision.

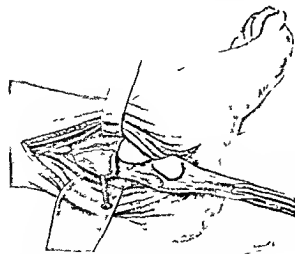


Fig. 5 The foot is put in a varo equinus position to show the posterior surface of the posterior marginal fragment which is held in place with a screw. Verification of the straight vertical line of the tibiotalar joint.

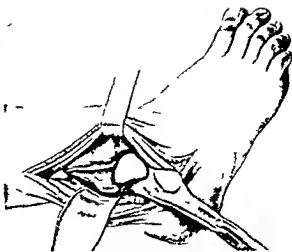


Fig. 4 The lower fragment of the fibula is turned down. The posterior muscles and the tendon of Achilles are held back with a retractor. The posterior marginal fragment is shown. Inspection of the tibiotalar joint.

First stage The skin incision begins 12 centimeters above the tip of the external malleolus, follows the posterior border of the fibula, which is easily found, curves a little forward at the lower end, and runs around the tip of the external malleolus (straight incision curved at the lower end, Fig. 1).

Second stage The edges of the incision are pulled back, thus exposing the external surface of the fibula and the fractured malleolus, and behind the bone the peroneal tendons in their sheaths can

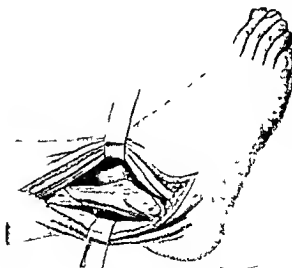
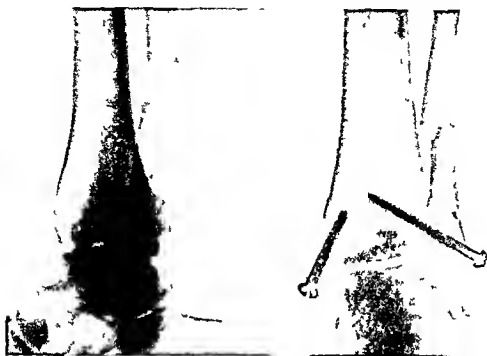


Fig. 6 Restoration to position of the external malleolus which is screwed to the tibia.



Figs 7 and 8 Bimalleolar fracture with posterior marginal fragment



Figs 9 to 12 Results in bimalleolar fracture with free posterior fragment and considerable deformity

be seen closely applied to the bone. The sheath is sectioned about 2 millimeters from the posterior border of the fibula. This section closely follows the skin incision and runs around the tip of the malleolus. The peroneal tendons are freed from their sheaths (Fig. 2).

Third stage. The peroneal tendons are pulled forward in front of the fibula and are held there with a Farabeuf retractor (Fig. 3). Note that in order to perform this step well it is necessary to detach from the fibula the lowest fibers of the peroneus brevis.

Fourth stage. The lower fibers of the flexor longus hallucis are detached from the posterior

surface of the fibula. If the anterior and posterior peroneotibial ligaments are still intact they are sectioned.

Fifth stage. The external malleolus is then turned around its tip from above downward. This manipulation is done without injuring the anterior and posterior peroneo astragaloid ligaments or the peroneocalcaneal ligament (Fig. 4).

Sixth stage. The assistant holds the foot in forced extension. The tendon of Achilles and the deep posterior muscles of the leg are held downward and backward with a retractor, the peroneal muscles being pulled forward. The field is quite large (Fig. 4) and there can be seen the posterior

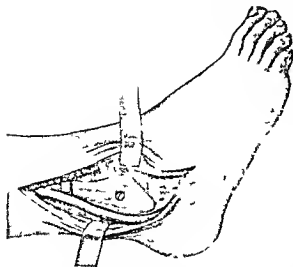


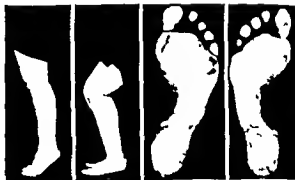
FIG. 13. Osteosynthesis of the fibula with a Parham ring. Restoration to position of the peroneal tendons.

and external surfaces of the lower end of the tibia (lower peroneotibial joint) and the posterior marginal fragment the peroneal surface of the astragalus, and the joint line which gapes widely.

Seventh stage. We now clean the joint line, remove the blood clots and small bits of bone, and irrigate with ether.

Eighth stage. We manipulate to reduce the luxation of the astragalus. The internal malleolus may interfere with this reduction. In that case the operator grasps the lower part of the leg with his left hand and the heel and the middle part of the foot with his right (if the fracture is on the right side). Because of the dislocation the repeated friction of the upper surface of the astragalus on the tibia pushes the internal malleolus inward and the reduction is effected. In case of failure a horizontal incision 3 centimeters long can be made below the tip of the internal malleolus, the focus of the fracture is reached and the internal malleolus reduced to the position before we return to the external incision. If the astragalus is properly reduced the fibular surfaces of the tibia and astragalus are plumb. The posterior marginal fragment is now reduced. Evidence of its reduction is furnished by perfect regularity of the joint surface of the tibia, which is well exposed, with the foot in extension and varus.

Ninth stage. The posterior marginal fragment is held in position with a screw. The tendon of Achilles and the tendons of the peroneal muscles must be held well away from the tip. The screw is directed obliquely from behind forward and from below upward (Fig. 5). The ex-



FIGS. 14 and 15. Shows perfect functional result.

ternal malleolus is next screwed to the tibia, the screw being directed from without inward and from below upward (Fig. 6). Immobilization of the external malleolus is completed by the coaptation of the two fragments (Parham's circle or second tibiofibular screw, depending on whether the fracture is oblique or transverse (Fig. 13)).

Tenth stage. If internal dehiscence has been necessary the operator returns to the internal wound and sutures the periosteum and the internal malleolus and the skin.

Eleventh stage. He then returns to the external wound, restores the peroneal tendons to their place, sutures the sheath and then the skin.

When the external malleolus and the posterior marginal fragment are in one piece, the external incision is sufficient. In very high fractures of the fibula the operator should not hesitate to section the fibula 7 centimeters above its tip in order to turn it down. In some cases the external malleolus may be attached to the posterior marginal fragment. As reduction of the fibula involves reduction of the marginal fragment a single peroneotibial screw is enough.

RESULTS

Figures 7 and 8 show a case of bimalleolar fracture with posterior marginal fragment. There was considerable displacement and non-operative reduction was impossible. The functional result was perfect (Figs. 14 and 15). The movements of the tibiotarsal joint are the same for the two limbs and the imprints of the soles can be superimposed.

The roentgenograms, Figures 9, 10, 11, and 12, show a diagrammatic bimalleolar fracture with a free posterior marginal fragment with considerable deformity, which necessitated both the external retroperoneal and internal tibial incisions. One screw was used for the posterior marginal fragment, one for the external malleolus, and a Parham ring for the fracture of the fibula.

FROM THE UNIVERSITY OF CALIFORNIA MEDICAL SCHOOL

TECHNIQUE OF THE COMPLETE BREAST OPERATION

EDWIN I. BARTLETT, M.D., F.A.C.S., SAN FRANCISCO

THE technical procedure described by Halstead in 1894 marked the earliest efforts to effect a cure of carcinoma of the breast by radical surgery. In the intervening years, various modifications of the Halstead operation have been advocated such as other types of incision of the skin, saving of skin to enable closure without skin grafting, plastic procedures for complete closure, preservation of the muscles, etc., but none of these can be definitely classified as improvements inasmuch as they have lessened rather than enhanced the thoroughness of the procedure. It is the purpose of this article to emphasize the general principles of the original operation and to add a few details which may contribute to a more complete eradication of the disease.

The complete breast operation is indicated in all cases of carcinoma of the breast in which there is any hope of cure by surgical procedure. The earlier the diseased process, the smaller the tumor, and the more hopeful the outlook, the more thorough and painstaking and radical the operation should be. The only hope of cure lies in the complete removal of the growth, that is, the excision of the tumor with a wide margin of healthy tissue and this can be accomplished only before the cancer cells have passed into the inaccessible regions behind the sternum or into more distant regions. Therefore, operations for cancer in its earliest stages must never be limited to partial operations but must represent our best efforts in radical surgery.

There are two objectives in the complete breast operation: first, the complete eradication of the disease, and, second, the restoration of the patient to normal health with normal function of the remaining parts. To accomplish the former there is required a wide excision of skin, an extensive subcutaneous dissection, the removal of the sternal portion of the major pectoral muscle and the complete removal of all the axillary contents except the artery, the vein, and the large nerve trunks (Fig. 1). To attain the latter all axillary dead space must be eliminated and there must be not even the mildest form of infection in skin or subcutaneous tissues after closure of the wound.

TECHNIQUE OF THE OPERATION

Step 1. Skin incision and subcutaneous dissection. A roughly circular incision is usually pre-

ferred, depending, of course, somewhat on the location of the tumor in the breast gland. An attempt is always made to give at least 8 to 10 centimeters margin to the tumor, and in all instances all of the skin overlying the breast gland is taken away. This usually means a secondary skin graft or a primary closure by means of a very extensive plastic. The secondary skin graft is undoubtedly the best procedure because it not only insures the widest possible margin to the disease but also gives the best conditions for the proper closure of the axilla.

The incision penetrates the skin and the superficial layers of fat. The skin edges are grasped with Kocher hæmostats, enough of the skin proper being taken in the bite of the clamp to insure the holding. Damage to skin is disregarded because these areas of crushed skin are always cut away at the end of the operation. With these Kocher clamps putting tension on the skin edge, the knife, or preferably the cautery point, is laid against the under surface of the skin and the dissection backward away from the edge is begun (Fig. 2). One always tries to take all the subcutaneous fat off the underside of the skin flaps.

The subcutaneous dissection (Fig. 2) is carried backward until the skin is lifted off the chest wall medialward as far as the opposite border of the sternum, lateralward as far as the lateral border of the scapula, inferiorly to the costal margin, and superiorly to the clavicle. It will be found that this can be accomplished without any splitting of the skin flaps inasmuch as the area of skin removed is quite large and with a little manipulation the far removed recesses of the subcutaneous dissection can be reached.

Step 2. Chest wall dissection. Chest wall dissection (Fig. 3) is begun at the superior angle over the clavicular portion of the pectoralis major muscle and carried downward until the dividing line between the clavicular and sternal portion of that muscle is reached. In most instances the line of demarcation is easily seen and in some individuals there are two rather distinct muscles. Occasionally where there seems to be a single muscle the dividing line is located by dissecting downward over the outer surface of the muscle until one strikes some perforating vessels coming through the muscle. These always lie in the plane of

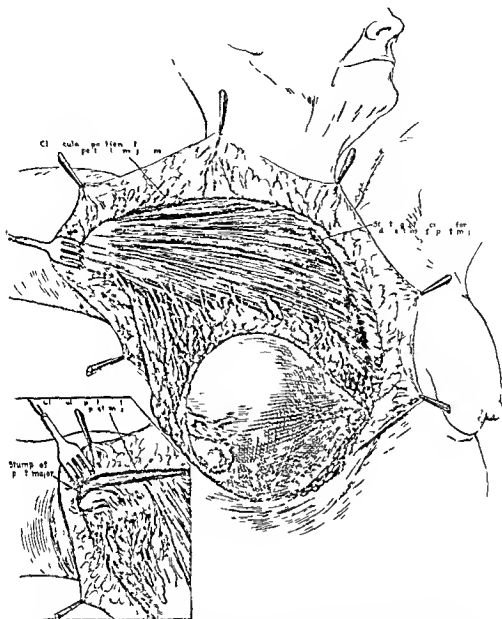


Fig 3 Upper and lateral limits of the subcutaneous dissection, the line of demarcation between the clavicular and sternal portions of the major pectoral muscle, the beginning of the division of the major pectoral muscle fibers (vulnerable angle) at the border of the sternum. The whole sternal portion of this muscle is to be taken. The outer end of the muscle is divided 2 centimeters or less from the bone (humerus). Inset shows underlying structures in outer axilla exposed by the removal of the sternal portion of the major pectoral muscle. Relationship of pectoralis minor muscle and clavicular portion of pectoralis major to the axillary contents.

are ligated. This part is done before the axillary dissection because here is the vulnerable angle at which the lymphatics from the breast penetrate through to the mediastinum. It is quite important that these be severed at the very earliest moment so as to prevent the passage, during operation, of the cancer cells by way of these lymphatics into the inaccessible regions.

The dissection is now carried lateralward (Fig 3) until the insertion of the pectoralis major

muscle on the humerus is exposed. When this muscle has been isolated, it is divided as close as possible to the humerus. The leaving of a long stump of this muscle on the humerus always means a visible and a palpable lump which the patient is very likely to suspect is a recurrence of her trouble. The sternal portion of the pectoral major muscle is now freed entirely from the chest wall and laid back to expose the minor pectoral and the axilla (Fig 4).

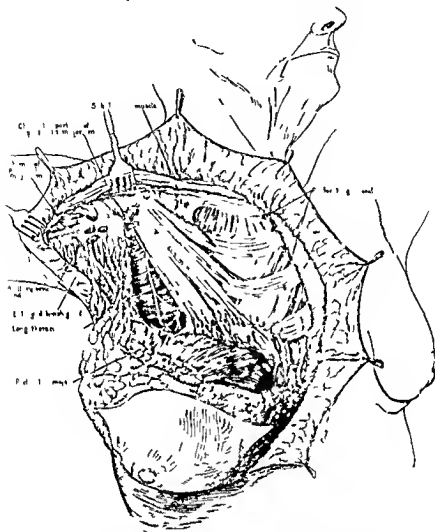


Fig 4 Immediate and some of the deeper structures to be dealt with after the removal of the sternal portion of the major pectoral muscle. The chest wall dissection up to this point is always done first because the chest wall especially that portion along the border of the sternum is the vulnerable area. It is important that the lymphatics paralleling the perforating vessels be divided very early in the operation. This closes the door by which carcinoma cells may pass behind the sternum to inaccessible regions. Note the areolar tissue on the outer surface of the minor pectoral muscle. This contains lymphatic vessels which sometimes form a communication between the axilla and the neck. Also note the subclavius muscle—an important structure in a later stage of the dissection. This muscle arises from the under surface of the middle third of the clavicle and inserts on the anterior surface of the first costal cartilage. It covers the last 2 centimeters of the axillary vein before this vessel disappears behind the clavicle.

The minor is isolated and divided about 5 to 8 centimeters from the coracoid process where it inserts (Fig 5). The cut ends of the distal portion are grasped with holding forceps, and the muscle is turned back over the clavicle. It serves as a retractor for the skin and for the clavicular portion of the pectoralis major muscle thus exposing the axilla to full view.

Step 3 Axillary dissection. First the axillary contents are dissected away from the under surface of the clavicular portion of the pectoralis major at the insertion on the clavicle. As the medial superior border of the clavicle is approached the subclavius muscle is encountered (Fig 5). It bridges the angle made by the clavicle and first rib and overlies the vein. This muscle is

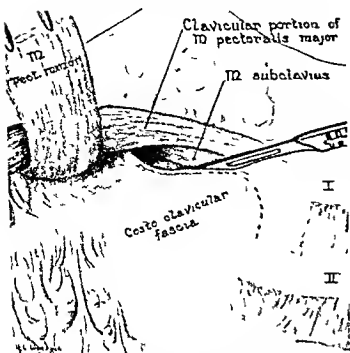


Fig 5 Showing point of division of pectoralis minor muscle. The muscle acts as a retractor to expose axilla. Showing division of fascia at outer edge of subclavius muscle preliminary to exposure of the axillary vein.

cleaned off by dissecting lateralward, or toward the operator, over its outer surface. A tough fascia (Fig 5) which unites with the outer edge of this muscle flush with its outer surface is nicked with a knife all along the subclavius up to the first rib. This same fascia which spreads out and attaches to the first and second ribs in a plane at right angles to the subclavius is then divided in a horizontal direction thus freeing it from the attachments to the chest wall. This accomplished, a sweeping or wiping outward and downward process quickly exposes (Fig 6) the vein and the plexus at the superior medial angle of the triangle. This puts the vein at the clavicle in full view and does away with danger of accidental damage to that vessel.

The axilla is now further exposed by a continuation of the wiping down process beginning well up underneath the clavicle cephalad to the vessels and plexus and directed downward at right angles to these structures. Here one is rather early held up by the cephalic vein which empties into the axillary vein superiorly about 2 centimeters from the clavicle. This vessel is usually preserved, simply being cleaned of its loose areolar tissue. Next are encountered some rather sturdy nerve filaments which pass over the vessels. These are divided because they supply the tissue being removed and are of no importance. The wiping down then continues practically without inter-

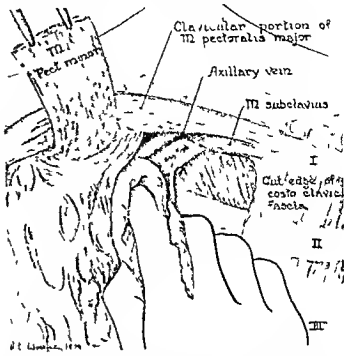


Fig 6 Illustrating the "wiping down" process after division of fascia with exposure of vein at the clavicle.

ruptions of any sort until the whole plexus is exposed and until the areolar tissue about the vein is laid bare (Fig 7).

At this juncture the dissection along the axillary vein is begun. With a rather sharp curved clamp the sheath of the vein is penetrated (Fig 7) at the point where the vein comes out from under the clavicle. The sheath is then split downward the whole length of the vein over the outer surface. This should accomplish a double purpose. It completely cleans the vein of all lymphatic glands which in some instances lie practically within the sheath of the vein. It also serves to isolate and identify all the branches of the axillary vein at the points of entrance into the vein so that they can be ligated flush against the wall of the axillary vein and before they have been torn (Fig 7, insert). It is quite important that no stump of these vein branches be left because the clots within these stumps may accidentally, during manipulation of the tissues at operation and during the postoperative movements of the arm, become dislodged and float around in the general circulation. Also such clots might lead to troublesome thromboses of the vein itself.

About 4 centimeters from the clavicle will be encountered an artery crossing over the outer side of the vein. This is the long thoracic artery and should be divided and ligated approximately 1 centimeter from its origin from the axillary artery. The arterial branches are best ligated with a

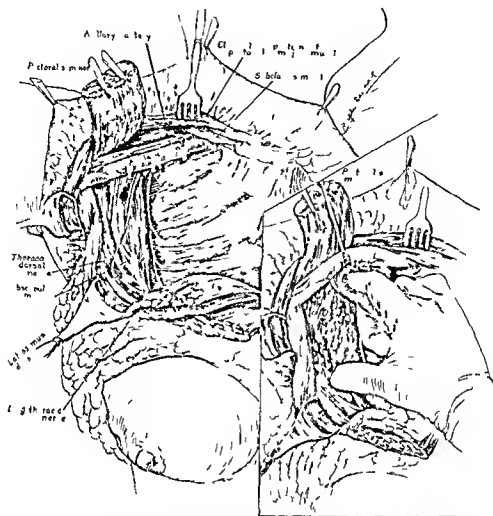


Fig 8 Axillary dissection completed showing structures remaining. Also showing "wiping down" methods employed for cleaning out the posterior axillary space after the dissection along the vein is completed. This exposes the long thoracic and the racodorsal nerves, thus avoiding division of these structures in the sharp dissection

considerable respiratory embarrassment and for some time after, cause the patient to complain of tightness and difficult breathing (Fig 8)

One or more nerve branches of the intercostals which come out in about the midaxillary line between the upper ribs may cause the operator to hesitate. These must be cut because they cross the axilla or embed themselves in the axillary contents in such a manner that the removal of the axillary contents in one piece cannot otherwise be accomplished. One of these, the intercostohumeral (Fig 8), sends branches to the arm supplying the integument of the inner surface down as far as the elbow. The division of this nerve gives a very unpleasant hyperaesthesia in its skin distribution which may persist for some time. Also the stump of this nerve may remain very tender causing much distress. On that account the nerve should be cut off very short so that the end retracts between the ribs

The result should now be as pictured in Figure 9. All the areolar tissue is gone from apex of axilla to costal margin. The walls of the cavity are clean muscle, rib surface and skin flaps. Only the vital nerve and vessel structures remain.

Closure It has often been stated that a surgeon should never close his own wounds, otherwise he may hamper himself by working through too small an incision or may fail to give enough margin to a malignant disease. One must go even further when considering the closure of a complete breast wound. One should never attempt to cover completely over the raw surfaces with skin flaps. Furthermore one should not try to leave as small a grafted area as possible because a large area completely covered with grafts heals as quickly as a smaller area. The only consideration is the complete occlusion of all axillary dead space and the avoidance of sloughing at any point through undue tension. The best results in

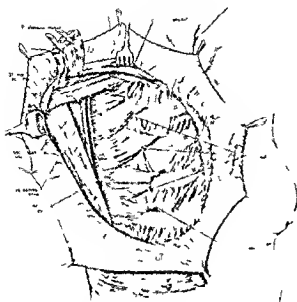


Fig. 9. Radical breast operation completed. All structures shown should be as clearly identified as illustrated and should be as clean of areolar tissue as shown in the sketch. Note especially the relationship of subclavian muscle to the under surface of the clavicular portion of the pectoralis major muscle and to the outer surface of the vein artery and nerves. Note the long thoracic and thoracodorsal nerves lying free and undamaged. Note the stump of the pectoralis minor muscle which is now tucked into the dead space above the vessels and nerve plexus.

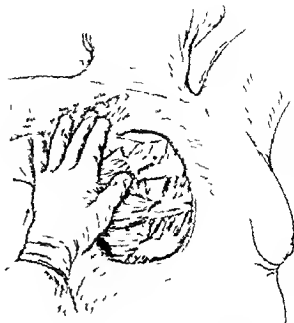


Fig. 10. Illustrating the arrangement of the skin flaps and the tucking in of the upper flap beneath the vessels and plexus.

closure of the axilla are obtained by Halstead's method described by him in one of his later papers. This consists of the tucking in of the axillary skin flap about the vessels and the maintaining of this position of the axillary flap by means of sutures which tack the skin to the chest wall (Figs. 10 and 11). By this method the minimum of pressure is required and therefore the minimum of bulk of dressings will suffice. In fact the flaps would almost maintain their proper position without dressings at all. A further advantage of this method is the freedom of the arm which is maintained, from the beginning, in full abduction.

The first dressing and skin graft are done on the third or fourth day. With the removal of the dry gauze from the raw area there is a very slight bleeding from the tearing of the fine capillaries which have worked their way into the gauze. This leaves an ideal bed for the grafts. Nitrous oxide is used for a few seconds while the grafts are cut from the thigh. The whole procedure can be done in the patient's room. The upset from the anesthetic and operation is negligible.

The second dressing is done about 3 or 4 days after the graft. For the remaining 6 or 8 days in the hospital the dressings are changed frequently and usually the wound is healed and without need of further care when the patient goes home on the fourteenth day after the primary operation.

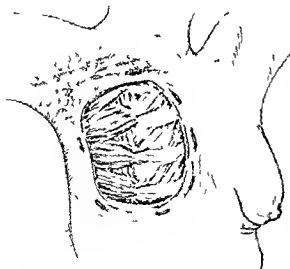


Fig. 11. Closure completed. Note the skin flaps tacked down without tension and the tucked up superior flap held down by mattress sutures. Note the flat axilla which results. The raw area is to be skin grafted.

THE MANAGEMENT OF STONE IN THE SOLITARY KIDNEY AND URETER¹

CHARLES PIERRE MATHÉ, M.D., F.A.C.S. SAN FRANCISCO, CALIFORNIA

From the Department of Urology Saint Mary's Hospital

SINCE early times the management of stone in kidney and ureter has been the subject of many articles, discussions, and urological congresses. Although numerous valuable contributions have been made concerning the treatment of stone, relatively few deal with calculus when it occurs in the solitary kidney or ureter due to congenital deformity or disease or surgical removal of its fellow. In operations on the solitary kidney and ureter, drainage of urine from the kidney must be assured at all times and treatment is most exacting. A patient possessing only one kidney is naturally very apprehensive, but he is willing to co-operate with the physician and usually follows any suggestions offered to rid him of stone and prevent recurrence.

In 1916, Beer emphasized that stone in the ureter of a solitary kidney should be removed by ureterolithotomy, rather than by attempts to remove it or cause it to pass by cystoscopic manipulation. In 1930, Keyes reported 5 cases on whom he had successfully removed calculi from the remaining kidney. Walters stated that in the 43 patients on whom an operation was performed on the solitary kidney and ureter at the Mayo Clinic, there was a mortality of 14 per cent and he stressed early intervention before renal insufficiency had set in making the patient a poor surgical risk. The management of stone-producing patients presenting a solitary kidney calls for intelligent employment of several prophylactic measures, earlier surgical intervention, the most exacting operative technique, and keen surgical judgment. In performing 13 operations for various pathological lesions in the solitary kidney and ureter, I was impressed by the lack of shock attending or following the surgical intervention. These consisted of one nephrolithotomy, one pyelonephrotomy, two ureterolithotomies, two nephropexies, two renal abscesses in which drainage was made, one decapsulation, and four ureterostomies into the skin of the lower abdomen one of which consisted of the implantation of a double ureter.

Having treated four patients in whom stones were found in a solitary kidney and ureter, I here-with present my cases.

CASE 1. E. S., a man, aged 58 years, a cobbler referred by Dr. Donald MacGedge, entered the hospital December

8, 1928, with complete urinary retention accompanied by fever, pain, and swelling in the region of the right kidney. At the age of 37 years he had had a nephrolithotomy for calculi in the left kidney, at 53 years a lithotripsy for bladder stone was done, at 54 years removal of a hypertrophied prostate and 6 months later left sided nephrectomy were done for pyonephrosis with recurrent stone formation in the kidney, and at 55 years I removed a calculus from the upper calyx of the remaining kidney by a nephrolithotomy incision. In order not to disturb the kidney the left rib was resected. Subsequent X-rays revealed the absence of stone. Later, however, he passed several small stones and, for the reason that it was thought that the chronic pyelonephritis present in the right kidney was a great factor in stone formation in his case, renal lavage and dilatation of the ureter were done at intervals for the purpose of reducing this infection and maintaining a wide passage in the right ureter. On December 7 he was suddenly taken with complete urinary retention, pain in the right lumbar region, chill followed by fever, and the appearance of a large mass in the right upper abdominal quadrant. A roentgenogram was made, on account of gas in the intestines no shadows suggestive of calculi were seen. The right ureter was catheterized and an obstruction was encountered 7 centimeters from the orifice, which was finally passed, liberating approximately 18 cubic centimeters of purulent urine under pressure. Following this ureteral manipulation a stone measuring 6 millimeters in diameter passed into the bladder and was removed by cystoscopic rongeur forceps. Although good drainage had been established, the enlarged right kidney did not recede in size and for this reason surgical intervention was made. The kidney on being exposed was found to contain numerous milium cystic abscesses on its convex surface. These varied from 2 to 5 millimeters in diameter and seemed to involve the entire kidney. We realized that we were dealing with sudden invasion of the cortex by an infection that had been present in the pelvis of the kidney over a period of years. The superficial abscesses were drained with little hope for improvement. A number of transfusions were given, however, the creatinine of the blood gradually climbed from 2.6 milligrams to 6 milligrams per hundred cubic centimeters and in 2 weeks' time the patient succumbed.

This case exemplifies the importance of early surgical removal of a stone blocking the ureter of a remaining kidney, particularly when the latter is infected. Had we seen this patient 36 hours sooner, before complete obstruction of the ureter had taken place, the removal of the stone would have prevented the invasion of the cortex of the kidney by infecting organisms that had been present in the pelvis over a period of years, and saved the patient's life.

CASE 2. W. I., hospital No. 51539, a man, aged 26 years, cheese salesman, referred by Dr. W. Lynch, entered St. Mary's Hospital, April 27, 1928, with repeated attacks of dull pain in the region of the left kidney, loss of weight, and

¹Read before the General Meeting of the San Francisco Medical Society May 13, 1930.

marked weakness. His symptoms began at the age of 21 years ureteral calculi were diagnosed in the lower left ureter at the age of 23 years and seven calculi were removed from the left ureter by ureterolithotomy at the age of 25 years. At the same time bilateral meatotomy of the ureteral orifices was also performed through the open bladder. Examination revealed a left pyonephrotic kidney containing a large coral type calculus in its upper pole and a smaller calculus in the lower pole. A large calculus in the lower portion of the left ureter and a huge right sided hydronephrosis. In performing the phenolsulphophthalalein test (intramuscular) 50 per cent was recovered in 2 hours. After being injected intravenously indigocarmine appeared of a dark blue color in 5 minutes on the right side and faintly in 7 minutes on the left side and remained very pale for 30 minutes. On May 10, 1928 a complete left ureteronephrectomy was made and a pyonephrotic kidney containing large stones and a ureter containing two stones measuring 3 centimeters by 1.5 centimeters were removed. The patient made an uneventful recovery but the pyelo nephritis which had always been present in the opposite kidney persisted. As it was thought to be a factor in stone formation in his case renal lavage with 1 per cent mercuric chrome and dilatation of the ureter were done at intervals for the purpose of reducing this infection and maintaining a wide passage in the ureter. A roentgenogram made on October 15, 1928 revealed a calculus about 1 centimeter in diameter in the lower pole of the right kidney and a larger stone in the right ureter. Succussion was applied after the manner described by Bransford Lewis and a radiogram made 3 days later demonstrated that the renal calculus had passed out of the kidney pelvis into the ureter lodging just above the intramural portion of the ureter below the larger stone. The ureteral orifice was widened by further slitting with a scissors and the ureters dilated with bougies but it was soon seen that the calculi were too large to pass by the lower portion of the ureter. On January 7, 1929 a ureterolithotomy was performed and two calculi 1.5 centimeters in diameter were removed from the pelvic portion of the ureter. The wound healed in 11 days and convalescence was uneventful. A roentgenogram made on April 15, 1930 was negative for stone and the urine analyzed on that date was negative.

This case exemplifies the tendency of certain patients to form calculi even in spite of all measures taken to eliminate stasis and to eradicate infection. This also demonstrates the lack of shock attending operation for stone on the remaining ureter, provided the patient has been properly prepared.

CASE 3. L. H. hospital No 61449 a man aged 32 years a plumber entered St. Mary's Hospital April 20, 1930 with complete urinary retention associated with vomiting, hic cough, pain, and swelling in the region of the right kidney. At the age of 29 years he was treated for ureteral stones of the left ureter. Following cystoscopic manipulations consisting of meatotomy of the orifice and dilatation of the left ureter a number of stones were passed. These procedures gave temporary relief and on December 20, 1929 I removed the left kidney and ureter because of tuberculous pyonephrosis with stone formation, ureteritis, advanced stricture formation, and impacted stones in the left ureter. The lumbar incision was slow in healing developed a lumbar sinus which was later resected and allowed to heal by secondary intention. On April 12, 1930 he developed an attack of severe renal crisis in the solitary

kidney followed by the passage of two small stones. On April 20 he developed a similar attack accompanied by complete urinary retention. A radiograph revealed a calculus in the region of the lower portion of the right ureter. Early the following day cystoscopy was performed for the purpose of passing a catheter by the obstructing calculus in order to establish drainage of urine. A stone 4 millimeters in diameter was seen to impact and completely obstruct the intramural portion of the ureter. By this time the right kidney had increased in size and palpation revealed that it had become considerably enlarged, apparently from an accumulation of urine in the pelvis. The stone was dislodged by the aid of a bougie. In changing its axis a gush of urine was seen to flow from the occluded orifice after which the patient experienced immediate relief from the sense of fullness and pain in the kidney above. As the patient had been dehydrated from constant vomiting it was deemed best to give him fluids by means of hyperdermoclysis under the pectoral muscles. Three or four hours were allowed for absorption of water after which I contemplated removal of the calculus in the lower ureter by ureterolithotomy. Ten minutes before the patient was to have been brought to the operating table the stone passed from the lower ureter into the bladder and was voided spontaneously. A roentgenogram was taken and revealed that the stone had passed.

This case exemplifies the predisposition of certain patients to form stones even after a pyonephrotic kidney and ureter had been removed on the opposite side. It also emphasizes the importance of early surgical intervention in cases presenting complete obstruction due to stone in the remaining ureter. Although it was impossible to pass by the stone by introducing bougies, these manipulations changed the axis of the stone, allowing urine to pass and relieve the back pressure present in the kidney, culminating in actual passage of the stone.

CASE 4. Mrs. M. H. hospital No 40429, housewife, aged 60 years entered St. Mary's Hospital June 20, 1926 complaining of pain in both kidney regions, increased frequency, dysuria, loss of weight and weakness. Urological examination revealed two calculi in the lower portion of the right ureter and an impacted calculus in the lower portion of the left ureter completely obstructing the outflow of urine. No function was found to be present in the left kidney and it was concluded that it was entirely destroyed by a pyonephrotic process. On May 21, 1926 a right sided ureterolithotomy was performed. On September 15, 1926, a left sided ureteronephrectomy was made for pyonephrosis, ureteral stone, and ureteritis with complete closure of the ureter. Three years later she developed characteristic symptoms of advanced rebellious cystitis and hydronephrosis of the remaining kidney, and in spite of repeated dilatations of the bladder and ureter under anesthesia the bladder contracted to 30 cubic centimeters and the lower portion of the right ureter became greatly constricted. On June 3, 1929 a right sided temporary nephrostomy was performed as a preliminary step to ureterostomy into the skin of the lower abdomen. The patient received such benefit from nephrostomy that ureteral transplantation has been postponed to a later date.

Because of dense per ureteral adhesions and marked tortuosity of the ureter it was necessary to make the incision into the ureter directly over the stone in order to

locate it for removal. Undoubtedly this incision into the portion of the ureter that had undergone cicatricial changes aided in subsequent stricture formation resulting in almost complete closure.

CASE 5 H T, hospital No. 28428, a man, aged 45 years, former middle weight prize fighter, entered St. Mary's Hospital February 11, 1924, complaining of pain and swelling in the region of the right kidney, the passage of gravel, hematuria, dysuria, edema of eyelids, loss of weight and weakness. At the age of 43 years a number of calculi passed from the right ureter following cystoscopic maneuvers consisting of meatotomy of the ureteral orifice and progressive dilatation of the ureter with bougies. In performing the phenolsulphonephthalein test 50 per cent was recovered in 2 hours after intramuscular injection. A roentgenogram revealed a calculus in the left kidney pelvis, an impacted stone in the right lower ureter, bilateral pyelonephritis and hydronephrosis on the right side. Twelve and one half per cent phenolsulphonephthalein was recovered from the right ureter and 5 per cent from the left ureter in one half hour after intravenous injection. Operation was advised, it being my purpose to remove the calculus from the left kidney in which the infection was less than in its fellow. Operation was refused and subsequent examination on October 6, 1924, revealed a calculus forming in the right kidney pelvis. Bilateral meatotomy and renal lavages were performed and progressive dilatations of the ureters were made following which the patient passed dozens of stones from the right kidney, the largest of which measured 1 centimeter in diameter. On October 21, 1924, a piece of one of the stones (which had rapidly increased in size and number in the right kidney) passed down the ureter and completely obstructed it. The patient presented huge swelling in the kidney region, ran a high fever, and was toxic. In spite of drainage of pure pus obtained by passing two No. 6 Charrière ureteral catheters beyond the obstructing stone, the patient became more toxic and progressively weaker. On September 26, 1924, a nephrectomy was performed and a large pyonephrotic kidney containing numerous calculi, the largest 5 centimeters in diameter, was removed. The ureteral calculus was grasped by a long forceps and removed through an opening in the ureter. The convalescence was somewhat stormy and the patient left the hospital 3 weeks later. Since that time repeated roentgenograms have been taken of the remaining left kidney. It has greatly hypertrophied and the calculus contained therein has taken on a coral shape and has almost entirely filled the pelvis and calyces and on February 6, 1930, measured approximately 8 by 3 centimeters. This calculus is apparently of a harder nature than those that had been present in the right kidney as no pieces have broken off. There has been no obstruction of the left ureter nor passage of small calculi. The patient has refused operation on the remaining kidney and in spite of the huge stone in his solitary kidney enjoys fair health some 6 years after nephrectomy for right sided calculus pyonephrosis.

This case exemplifies the importance of early surgical intervention for stone before renal insufficiency and advanced infection has set in, thus making the patient a poor surgical risk. It also demonstrates that stones, coral-form or otherwise, in which fragments separate and pass down the ureter should be removed at once. They might completely obstruct the ureter and in kidneys presenting chronic pyelonephritis cause invasion of the cortex by the infecting organisms present, resulting in complete destruction of this organ.



Fig. 1 A, left. Male, aged 53 years. Roentgenogram showing round shadow in region of upper pole of solitary right kidney. Opposite kidney previously removed for recurrent calculi and pyonephrosis. B, Pyelogram localizing calculus in upper major calyx. Successfully removed by nephrotomy. Case 1.

CASE 6 M O B, hospital No. 29376, a man, aged 29 years, laborer, entered St. Mary's Hospital January 10, 1929, complaining of frequency, persistent pyuria, dizziness, and palpitation of the heart of 5 years' duration. Seventy per cent phenolsulphonephthalein was recovered in 2 hours after intramuscular injection. Roentgenographic examination revealed two irregular calculi in the upper and middle calyces of the right kidney and absence of the left kidney. The ureter above the left orifice in the bladder was completely closed. Urines collected from the right kidney and bladder showed numerous leucocytes, erythrocytes, colon bacilli and staphylococci, and were negative for tuberculosis. On January 23, 1929, both calculi were removed from the upper and middle calyces of an enlarged kidney apparently due to compensatory hypertrophy by a pyelo-nephrotomy incision. An abscess was found in the lower pole which was also opened and drained. No hemorrhage followed, and although the incision did not heal for 8 weeks, it was finally closed by the employment of indwelling catheters. Subsequently the pelvis was treated by renal lavage. The urine has greatly improved and a radio-graph taken in February, 1930, was negative for stone.

TREATMENT

The treatment of stones in the solitary kidney and ureter can be divided into prophylactic and surgical. When it has been necessary to remove a kidney because of calculus pyonephrosis, be it due to advanced infection or the formation of abscesses resulting in more or less complete destruction of the parenchyma, one should divert his attention to certain prophylactic measures preventing the formation of stone in the healthy fellow. In a given case of bilateral renal calculi in which one kidney is destroyed by advanced infection or hydronephrotic atrophy, surgical attack should first be directed to the removal of the

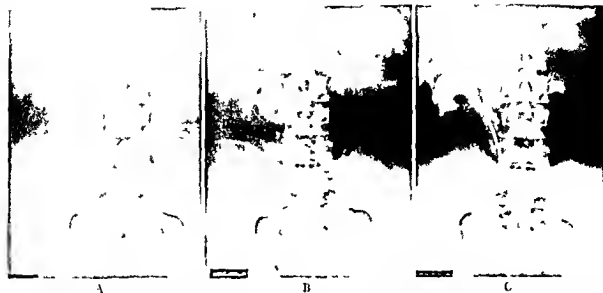


Fig 2 A Male aged 26 years. Roentgenogram showing recurrent calculus in lower ureter and formation of a new calculus in solitary kidney. Opposite kidney and ureter removed because of recurrent calculi formation and pyonephrosis. B Roentgenogram taken 3 months later showing passage of kidney stone following succussion. One can observe the new position taken by this calculus which is

below the larger ureteral stone. C Ureteropyelogram showing position of the stones in the ureter. Calculi removed by ureterolithotomy. On April 15 1930 the urine was negative and a roentgenogram taken at that time showed no calculi. There is a clinical relief of symptoms. All possible foci of infection have been removed. Case 2.

calculus from the functioning kidney, and at a later date the other useless kidney should be removed.

Prophylactic. In certain cases of nephrolithiasis early nephrectomy for calculus pyonephrosis removes the focus of infection which is often the cause of infection and stone formation in the opposite kidney (Nicolich, Rossing, and Rafin). Roentgenograms should be repeatedly taken at intervals in order immediately to detect recurrence or the formation of a new stone. The urine should likewise be examined monthly for pus and blood the presence of which points to infection with or without stone. The finding of macroscopic or microscopic blood without pus usually indicates the recurrence of calculi. All foci of infection should be eliminated, diseased tonsils should be removed, abscessed teeth extracted, infected sinuses drained, and infections in the prostate, seminal vesicles, uterus, tubes, and ovaries eradicated. Likewise, infections in the bladder should be cleared up. Because of the great rôle of stasis in the formation of stone one should make sure that the drainage of urine is unimpeded. Obstructions in the lower tract should be relieved, urethral strictures should be dilated, an obstructing prostate should be removed, and median bars should be tunneled by the electrocautery or punch operation. Congenital stricture of the ureteral

meatus should be divided by the cystoscopic scissors or fulguration. Hunner has called attention to the rôle of ureteral stricture in the formation of kidney stone. Progressive dilatation of the ureters should be made in all cases of congenital and acquired stricture. Stasis of the kidney due to ptosis should be relieved by nephropexy and congenital constrictions of the ureteropelvic junction should be corrected by the proper plastic operation. Extra ureteral pressure caused by anomalous vessels should be relieved by resection of the obstructing vessel. Lesions of the pelvic organs which encroach upon and obstruct the ureter should be surgically removed. Infection of the remaining kidney should be systematically and energetically eradicated. Pelvic lavage should be employed until the kidney is freed from infection. In performing kidney lavage in patients prone to stone formation, one may not employ silver nitrate as it tends to aid the formation of stone by depositing silver chloride on any nucleus that might be present, be it bacteria, mucus, etc. It is better to employ rivanol, 1:4000, the albuminoid silver salts, mercurochrome 220 ($\frac{1}{2}$ to 1 per cent), etc. Obstinate cases can be greatly benefited by the local injection of the bouillon filtrate of an autogenous vaccine prepared from the patient. It contains an antiviral, is injected directly into the pelvis, and acts by virtue of its local immunizing



Fig 3 A, left. Female aged 60 years. Roentgenogram showing calculi in the right lower ureter in apposition with the opaque catheter. Opposite kidney destroyed by complete obstruction due to calculus in lower ureter which is seen in left side of bony pelvis. B. Uroteropyelogram localizing calculi in ureter and demonstrating hydro-ureter and hydronephrosis. Calculi of right ureter removed by ureterolithotomy. Left pyonephrotic kidney and ureter removed at later date. Case 4.

power. The patient should be placed on a low protein diet, advised to abstain from irritating rich foods, and to drink distilled water. In their zeal to combat acidity and to prevent stone formation some patients take in alkaline producing vegetables, citrous fruits and alkaline waters, etc., in excess overloading the urine with crystalloids favoring the formation of stone.

TREATMENT OF STONE IN THE SOLITARY KIDNEY

When one is called to deal with stone in the solitary kidney all efforts possible should be directed toward conservation of renal tissue. Drainage of urine from the kidney must be assured at all times as there is no opposite kidney to fall back upon for elimination of waste products. Surgical procedures must be of a nature to assure the integrity and unimpairment of as much renal tissue as possible. In attacking the kidney surgically, great care and gentleness should be exercised in exposing the kidney as the least accident might prove fatal. In attacking the kidney one should avoid sacrificing blood vessels which would interfere with the nutrition of the kidney. If the stone is located in the upper pole one should not hesitate to resect the last rib facilitating the approach and removal of the stone. In such cases the calculus can often be removed without delivering the kidney into the incision. One must be certain not to leave any fragments which might act as a nucleus

for future stone formation. If the stone is located in the pelvis, is smooth, and easily accessible it can be removed by a simple pyelotomy incision. If it is located in one of the calyces its removal through a pyelotomy incision might cause one to leave a fragment which will act as a nucleus and aid in

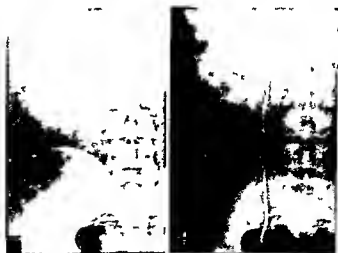


Fig 4 A, left. Man, aged 29 years, presenting irregular shadows in region of middle portion and upper pole of congenital solitary right kidney. B, Uroteropyelogram localizing these calculi and demonstrating an abscess of the lower pole. Stones removed by pyelonephrotomy and abscess of lower portion drained at time of operation. Clinical relief of symptoms and no recurrence of stone to date. Case 6.

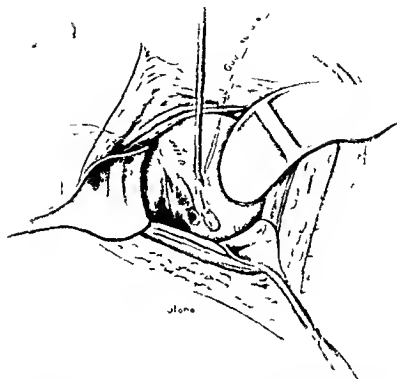


Fig. 5 Ureterolithotomy for calculus situated low down in the pelvic portion of the ureter. When possible the stone is milked up into the incision or grasped by a long forceps which facilitates the operation. Incision in the healthy portion of the ureter assures better healing and less subsequent stricture formation.

future stone formation. I have noted the reformation of stone in 3 patients in whom the stone was removed by the aid of a forceps from a calyx through the pyelotomy incision. Unquestionably, a small fragment was left behind. The employment of fluoroscopy as suggested by Braasch and Carman and the taking of films at the time of operation (Quinby) is a great aid in localizing and assuring the removal of all stones and fragments. A stone in a major or minor calyx is best removed by making a combination pyelotomy and nephrotomy incision. The pelvis is opened sufficiently to allow one to insert the index or little finger. The stone is palpated and kept in place by firm gentle pressure. At the same time it is located from without by the aid of a small groove director or blunt needle which acts as a guide for opening the parenchyma with a silver wire. The stone is then extracted with forceps or pushed out from its

bed by the finger below. In this manner there is less likelihood of breaking off or leaving fragments. If the stone is of soft consistency and there is a likelihood of its being broken a thorough lavage is made of the pelvis in order to wash away small particles. The pyelotomy incision should not be closed by suture thereby assuring good drainage. After the operation partial decapsulation is performed in advanced cases in order to minimize postoperative renal congestion. Partial decapsulation is performed by incising the capsule and separating it from the kidney with the finger for a slight distance only. This assures the minimum amount of kidney surface adhering to the surrounding structures and facilitates surgical approach should it become necessary to operate on the kidney at a future date. One is impressed by the lack of shock and the absence of any alarming diminution of renal function after this operation.

TABLE I — PROPHYLACTIC MEASURES IN THE TREATMENT OF CALCULUS IN SOLITARY KIDNEY AND URETER

- 1 Early removal of unilateral calculi and calculus pyonephrosis
- 2 Cleaning up of foci of infection
 - A Furuncles, boils, and carbuncles—open drainage
 - B Infected tonsils—tonsillectomy
 - C Infection of sinuses and ear—open drainage
 - D Abscessed and pulpless teeth—extraction
 - E Infected prostate and seminal vesicles—routine massage surgical drainage
 - F Infected genital organs in women—removal of infected tubes, cauterization of cervical glands, etc
- 3 Cleaning up of stasis
 - A Upper urinary tract
 - 1 Meatotomy of ureteral orifice
 - 2 Progressive dilatation of ureter
 - 3 Removal of extra ureteral pressure anomalous vessels and lesions of genital organs in the female
 - 4 Increased mobility with linking of ureter—support with belt, nephropexy
 - 5 Surgical correction of obstructions at ureteropelvic junction
 - B Lower urinary tract
 - 1 Urethral stricture—dilatation, urethrotomy
 - 2 Median bar vesical neck—electrocauter, punch operation, open operation
 - 3 Hypertrophied prostate—prostatectomy
 - 4 Bladder stone—lithotrpsy—cystolithotomy
- 4 Cleaning up of chronic pyelonephritis
 - A Renal drainage and lavage at intervals
 - B Lavage of bladder to minimize reinfection of kidneys
 - C Internal and intravenous administration of urinary antiseptics
 - D Vaccinotherapy—local immunization by injection of filtrate directly into renal pelvis
- 5 Regimen
 - A Bland, low protein diet
 - B Intake of distilled water only
 - C Prohibition of excesses in drinking and eating
- 6 Prophylactic examination of patient
 - A Roentgenograms of entire urinary tract every 3 to 6 months
 - B Monthly complete urine analysis

Unfortunately, operation for stone in the solitary kidney is often delayed because of ignorance on the part of the profession as to its relative safety. Patients are allowed to go on until irreparable damage has taken place, transforming a good subject for surgical relief into a bazardous risk.

TREATMENT OF URETERAL STONE

It is a well proved fact that about 90 per cent of ureteral stones can be caused to pass by cystoscopic maneuvers such as meatotomy of the ureteral orifice, dilatation of the ureter by means of catheters and bougies, rubber bags, mechanical dilators, etc. Excepting in the patient presenting impacted and unduly large stones and in cases of

TABLE II — OPERATIONS ON SOLITARY KIDNEY AND URETER

| | Cases |
|-----------------------------------------|-------|
| Nephrolithotomy for stone | 1 |
| Pyelonephrotomy for stone | 1 |
| Ureterolithotomy for stone | 2 |
| Nephropexy | 2 |
| Renal abscess | 2 |
| Decapsulation of kidney | 1 |
| Ureterostomy into skin lower abdomen | 3 |
| Ureterostomy of double ureter into skin | 1 |
| Total | 13 |

TABLE III — TREATMENT OF STONE IN SOLITARY KIDNEY

- 1 Cystoscopic maneuvers to cause passage of stone—dangerous. Rarely employed.
 - Surgical points in technique
 - A Wide incision, resection of last rib for larger exposure
 - B Extreme gentleness
 - C Avoid sacrificing blood vessels
 - D Pyelotomy for smooth stones in pelvis
 - E Pyelonephrotomy for large irregular stones and those in calyces
 - F Pyelotomy incision not sutured
 - G Decapsulation

TABLE IV — TREATMENT OF STONE IN SOLITARY URETER

- 1 Cases very limited in which cystoscopic maneuvers can be safely utilized. Danger of obstruction and anuria.
- 2 Surgical points in technique
 - A Preliminary drainage and lavage of pelvis through ureteral catheter
 - B Retention catheter at time of operation
 - C Incision in ureter above side of stone and stone removed by forceps or milking
 - D Ureterotomy incision not sutured
 - E Careful replacement of ureter to prevent undue angulation

advanced infection the efficacy of this procedure is without question. Following dilatation of the ureter by bougies, the actual descent of the stone is brought about by changing the axis of the stone or by the propulsive force of the urine. This is in a measure due to oedema caused by instrumentation at the site of the obstructing stone (Beer). The resulting increased pressure behind the stone acts as a driving force. When stone occurs in the solitary ureter such blockage of the passage over an appreciable length of time causes anuria and results in rapidly forming uræmia and death. If there has been pre-existing infection in the kidney in the form of pyelonephritis, this back pressure will often cause involvement of the parenchyma by the infecting organisms present resulting in acute suppurative nephritis with the formation of multiple cortical abscesses. This pathological process is well exemplified in Cases 1 and 4 in

which a calculus completely blocked the ureter resulting in invasion of the cortex by an infection that had been present in the pelvis for years forming multiple milary abscesses entirely destroying the parenchyma resulting in destruction of the kidney in one and in uræmia and death in the other

One should attempt to establish preliminary drainage by means of passing a ureteral catheter by the obstructing calculus in the ureter. If the stone is tightly impacted or embedded in the ureter it is sometimes impossible to pass even in spite of placing the patient in the exaggerated Trendelenburg position and in spite of maneuvering filiforms, bougies, and catheters of all description and angles. The catheter should be left in place. It assures drainage of urine and acts as a guide for the location of the stone when surgical intervention is made. It is of particular aid when per ureteritis or huge dilatation of the ureter has rendered its palpation or visualization difficult. If the stone is located low down in the ureter its removal can be greatly facilitated by making an incision above the stone and extracting it by the aid of a small forceps (Fig. 5). In some cases the stone can be milked up into the incision where it is readily removed. The incision in the healthy portion of the ureter well above the site of the stone, where it often has caused more or less ureteritis and per ureteritis assures better healing and is more likely to eliminate the possibility of subsequent stricture formation. It is well not to close the ureter by suture but to leave it wide open to assure sufficient drainage. After the stone has been removed one should make sure that the ureter is replaced in its proper place eliminating the possibility of forming an abnormal angulation which would later impede the outflow of urine.

SUMMARY

1. The management of stone in the solitary kidney and ureter includes many prophylactic measures, viz. the early removal of unilateral calculi and nephrectomy for calculus pyonephrosis which might act as a focus for stone formation in its healthy fellow, the clearing up of all foci of infection in other portions of the body, the elimination of stasis in the upper and lower urinary tract, the eradication of infection in the remaining kidney, and a careful regimen and limitation of diet and abstinence of excesses in eating and drinking.

2. Five cases are reported, the clinical cause of which emphasize the early removal of stone from the solitary kidney before renal insufficiency and advanced infection have set in often transforming

a good subject for surgical relief into a hazardous risk. When performed, early lithotomy on the solitary kidney and ureter is a benign operation followed by practically no shock and tolerated as well as by patients possessing two kidneys.

3. Attempts to cause stones to pass from the solitary kidney pelvis or ureter by cystoscopic maneuvers are dangerous because the stone, in passing, is likely to obstruct the ureter. In cases presenting chronic pyelonephritis this obstruction is likely to cause invasion of the parenchyma by the infecting organisms present, resulting in destruction of the kidney, anuria, uræmia, and death.

4. Surgical removal of stone from the solitary kidney and ureter calls for the most exacting operative technique and keen surgical judgment. Preliminary drainage and lavage should be made through the ureteral catheter. A wide incision assuring good exposure should be made, extreme gentleness should be employed in handling the kidney, blood vessels should not be sacrificed, and the incision in the pelvis and ureter should not be sutured in order to assure drainage. A combination pyelotomy and nephrotomy incision assures entire removal of the stone and is less likely to be followed by recurrence. Decapsulation should be made to avoid postoperative renal congestion.

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THE CONSERVATIVE TREATMENT OF PREPATELLAR BURSITIS¹

A STUDY OF TWENTY SEVEN CONSECUTIVE CASES WITH FOLLOW-UP RESULTS

LOUIS CARP M D F A C S, NEW YORK

THE common affections of the prepatellar bursa are those due to acute inflammation with or without suppuration, chronic simple inflammation, tuberculosis, or syphilis. This paper is concerned with both acute and chronic inflammations ("house-maid's knee") producing a painful or non painful swelling without calcification and with fluid of a non-purulent character present.

The opinions of various men as to the treatment of this condition are of interest. Jones and Lovett state "If from the patient's neglect or other causes the condition becomes chronic, the bursa should be dissected out." Telford says "For the larger and older cases the extirpation of the sac is the only possible treatment, aspiration and injection are futile and may be dangerous." Reder advised incision and drainage of non-suppurative prepatellar bursitis but in chronic cases complete excision of the bursa. Hoffman among others, advocated puncture of the bursa, expression of its contents, scarification of its walls and firm bandage pressure. He had 104 cases. In 2 cases, this procedure was carried out twice, in 4 cases three times, while in 98 cases it was successful after one treatment. The length of the follow-up is not given. Field and Allen report traumatic subcutaneous rupture of the prepa-

tellar inflamed bursa. In Field's case the swelling was not in evidence 6 months later. Among those who have reported a few cases treated by aspiration, or aspiration and injection of a chemical irritant, are Heath, Morse, and Favardin. No late follow-up results are given.

Maingot records the excision of a partially calcified prepatellar bursa of 30 years' duration in a woman of 56. It measured $11\frac{1}{2}$ by $9\frac{3}{4}$ inches and weighed 63 ounces.

In 24 of 27 consecutive cases of non-suppurative prepatellar bursitis treated in the out-patient-department of the Presbyterian Hospital, successful end-results were obtained without operative therapy. In the 3 remaining cases there was no follow-up.

The technique employed is simple. A needle of sufficient caliber attached to a 20 cubic centimeter syringe is inserted, without an anæsthetic, into the bursal cavity. The fluid is evacuated as completely as possible and then from 2 to 5 cubic centimeters of half strength, 3.5 per cent, tincture of iodine is injected into the bursa. The needle is withdrawn and the skin of the bursa massaged vigorously in order to disseminate the iodine in the bursal sac. The patient may now feel a burning pain. The knee is placed in complete extension.



Fig. 1. Lateral view of knee of a 21 year old male (Case No. 123008) who had a traumatic prepatellar bursitis of 7 weeks' duration.



Fig. 2. Photograph of bursa excised in case in Figure 1 after bisection. There is a pale, smooth fibrous lining. Scattered over the surface of this are many elevated dark reddish papillary projections from 1 to 3 millimeters in diameter. From one of these a slender thread of tissue passes from one side of the sac to another. (Courtesy of Dr. A. P. Stout.)

¹From the Presbyterian Hospital, College of Physicians and Surgeons, Columbia University.

TABLE I.—TWENTY SEVEN CASES OF PREPATULAR BURSTITIS TREATED BY AUTHOR'S METHOD

| Case No. Date | Age Sex | Occupation | Trauma | Side | Symptoms | Signs | Amount of fluid in bursa | Culture | Amount of chemical injected | Course after treatment | Result |
|--------------------|---------|------------|---------------------------|-------|------------------------------------------------------------|----------------------------------------------|-----------------------------|----------|-----------------------------|----------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------|
| 2743 2-22-22 | 27 F | Hon wife | Fell on knee | Right | Discomfort in walking. Immediate swelling | Swelling on front of knee | 10 cc fluid | Negative | 2 cc 5% iodine | 1 week small amount fluid no symptoms 3 weeks well | 3 years well |
| 22502 3-22-22 | 2 F | None | Prays on knees | Right | Swelling | Swelling on front of knee | 25 cc fluid | Negative | 3 cc 5% iodine | Pain for 2 days no fluid 3 days no pain 1 fluid 1 day 5 small amount fluid | 2 years well |
| 110102 12-26-22 | 51 F | Hon wife | Struck knee | Right | Swelling 2 in 24 hours | Swelling | 20 cc fluid 1/2 brown fluid | Negative | 5 cc 5% iodine | 2 days no pain nor swelling 3 weeks well | 3 years well |
| 69609 20-15-10 | 50 F | Housewife | Fell on knee | Right | Pain and tenderness swelling 6 in 10 hours | Swelling 4 x 5 cm fluctuant | 20 cc fluid | Negative | 2 cc 5% iodine | 0 days red 1 day no pain 10 days fluid injection to drop pure carbolic to 10 days well | 6 years well |
| 11330 8-10-25 | 47 F | Housewife | Scrub on knee | Left | Swelling (several weeks) | Fluctuant | 10 cc fluid | Negative | 5 cc 5% iodine | 1 week no fluid 2 weeks well | 3 years well |
| 82545 4-23-10 | 53 F | Housewife | Kneels | Right | Swelling pain (1 in 10 hours) | Swelling 4 x 4 cm fluctuant | 4 cc fluid | Negative | 5 cc 5% iodine | 10 days 8 cc fluid 10 days well | 0 years no swelling nor symptoms |
| 169376 1-3-27 | 40 F | Cook | Fell on knee | Right | Painful swelling | Fluctuant tender swelling | 10 cc fluid | Negative | None at first | 0 days fluid reabsorbed late 20 cc fluid 10 days well | 14 months well |
| 137018 4-4-27 | 45 F | Student | Fell on knee | Left | Impaired motion swelling 1 in 10 hours later 1 in 20 hours | Fluctuant swelling | 10 cc fluid | Negative | 3 cc 5% iodine | 3 days little fluid present 9 weeks light fluid well | 3 months well |
| 161254 6-8-27 | 16 F | Student | Fell on knee 6 months ago | Left | Swelling | Fluctuant swelling | 5 cc fluid | Negative | 1 cc 5% iodine | 6 months fluid persisted 45 cc clear straw-colored fluid 10 days 10 months 3 cc 5% iodine injected 7 months swelling | 1 year well 2 x 2 cm thickening in the groin of bursa |
| 166573 12-22-27 | 32 F | Fireman | | Right | Swelling a days | Swelling 4 x 5 cm fluctuant, slightly tender | 40 cc clear bloody fluid | Negative | None at first | 16 days red 1 day no pain 10 days fluid injection to drop pure carbolic to 10 days well | 4 months no swelling nor pain |
| 5155 2-3-28 | 31 F | Carpenter | | Right | Non painful swelling | Swelling 4 x 7 cm | 5 cc opaque bloody fluid | Negative | 3 cc 5% iodine | 1 week no symptoms nor fluid | 3 months well |
| 109871 9-28-26 | 40 F | Housewife | Bruise | Right | Swelling appeared in 3 months | Swelling 4 x 7 cm | 5 cc fluid | Negative | 3 cc 5% iodine | 0 weeks well | 0 weeks well |

| 89555 10-12-10 | 43 F | Cleaner | Fell on knee | Right | 2 months later swelling 1 month | Prepatellar bursa, tense no tenderness | Swelling | 6 cm bloody fluid | Tincture of iodine | 2 weeks slight return fluid 4 weeks well | 4 weeks well |
|-------------------|---------|-------------|----------------------------|-------|-----------------------------------------------------------------|----------------------------------------------|--------------------------------------------------|-----------------------------------|---------------------------|-------------------------------------------------------------------------------------------------------------------|--------------------------------------------|
| 76153 1-0-10 | 64 F | Housewife | | Right | Swelling for 1 month | Swelling | Swelling 2.5 cm in diameter | 80 c cm thin bloody fluid | 2 c cm 3.5% iodine | 3 weeks well | 3 weeks well |
| 90887 8-10-10 | 53 F | Cleaner | On knees while cleaning | Right | Lump for 4 years | Swelling | Swelling size of marble orange | 30 c cm bloody fluid | 10 drops pure carbolic | 3 weeks no fluid | 4 weeks well |
| 91212 9-11-0 | 57 F | Housewife | | Right | Swelling | Swelling size of marble orange | Swelling 2.5 x 3 cm Skin purplish | 30 c cm bloody fluid | 2 c cm 3.5% iodine | 1 week slight resaccula- tion fluid | 3 weeks slight return fluid in bursa |
| 9157 12-1-10 | 25 F | Housewife | Fell on knee | Left | Pain and soreness several days Swelling 2 months later | Swelling | Swelling 1 x 3 cm tuberculous plaques felt | 12 c cm bloody fluid | 10 drops 10% iodine | 2 weeks well | |
| 1001 10-15-10 | 25 F | Waitress | Fell on knee | Right | Swelling 1 week later | Swelling | Swelling 1 x 3 cm tuberculous plaques felt | 12 c cm bloody fluid | 2 c cm 3.5% iodine | 2 days small amount of fluid 6 days aspiration 3 c cm brownish fluid | 3 weeks well |
| 10000 9-11-10 | 31 F | Housewife | Struck knee | Right | Immediate swelling | Swelling | Swelling 5 x 3 cm | 8 c cm fluid | 1 c cm 3.5% iodine | 2 days pain small amount of fluid 1 week small amount of fluid | |
| 11400 1-1-10 | 40 F | Chambermaid | | Right | Swelling 3 months | Swelling | Swelling 6 x 5 cm | 15 c cm clear yellow fluid | 3 c cm 1.5% iodine | 1 week 5 c cm fluid aspir- ated 5 days 3 c cm fluid aspirated | 2 weeks well |
| 11943 1-12-10 | 19 F | Housewife | | Right | Painful swelling 6 weeks | Swelling | Swelling 3 x 3 cm fluctuant | 20 c cm bloody fluid | 2 c cm 3.5% iodine | 2 days fluid present aspi- rated 5 days 3 c cm serousanguineous fluid | |
| 140612 6-14-10 | 6 F | Housewife | | Right | Pain and swelling 4 weeks | Swelling | Swelling 7 x 6 cm fluctuant | 15 c cm bloody fluid | 1% iodine | 3 days no swelling 12 days slight swelling well | |
| 14131 6-1-10 | 6 F | Lumber | Fell on knee | Left | Swelling (several days) | Swelling | Large swelling | 15 c cm bloody chocolate fluid | 5 c cm 3.5% iodine | 2 days fluid in bursa 4 days less fluid 6 days 10 c cm reddish fluid aspir- ated 3 days some swelling | |
| 1501 3-4-10 | 12 F | Housewife | | Left | Painful swelling 3 weeks | Swelling | Swelling | 50 c cm light yellow fluid | 1 c cm 2% iodine | | |
| 17056 1-11-10 | 27 F | Janitor | Struck knee | Left | Swelling | Swelling | Swelling | 15 c cm clear amber fluid | 1.5% iodine | | |
| 17071 1-13-11 | 35 F | Steward | Fell on knee | Right | Painful swelling | Swelling | Swelling | | 1/100 phenol | | |

1. King (10) and that the bursa fluid occasionally had the character of a transudate with a specific gravity of about 1.020 and with relatively few cells. The icteric index was between 2 and 5 in the transudates, relative to the inflammatory fluid is. Haemorrhagic fluid gave a high icteric index, below 10 and so some of these follow-up results were not seen by the writer but while being treated in other departments in the hospital the patients made no complaints about the bursitis.

TABLE II—ANALYSIS OF TWENTY SEVEN CASES OF PREPATELLAR BURSTITIS

| Age in years | |
|--------------|------|
| Oldest | 72 |
| Youngest | 15 |
| Average age | 40.6 |

| Sex | |
|---------|-------|
| Males | 5 19 |
| Females | 22 81 |

| Occupation (in order of frequency) | |
|------------------------------------|----------|
| Cases | Per cent |
| 1 Housewife | 14 53 |
| 2 Cook | 2 7 |
| Cleaner | 2 7 |
| Student | 2 7 |
| 3 Miscellaneous | 7 26 |

| Trauma | |
|--------------|-------|
| Positive | 18 67 |
| Negative | 0 0 |
| Not recorded | 9 33 |

Duration—20 cases

In five cases (25 per cent) the swelling appeared immediately. In the 15 remaining cases it appeared in days, weeks or months. At time of first observation the shortest time for appearance of swelling was immediately, the longest 4 years (1 case) average 1½ months (excluding the 4 year case).

| Analysis chief complaints | |
|---------------------------|----------|
| Cases | Per cent |
| 1 Swelling | 21 68 |
| 2 Pain | 8 26 |
| 3 Discomfort on walking | 1 3 |
| 4 Tenderness | 1 3 |

| Analysis of objective symptoms | |
|--------------------------------|----------|
| Cases | Per cent |
| 1 Swelling | 27 100 |
| 2 Fluctuation | 7 26 |
| 3 Tenderness | 3 11 |
| 4 Discoloration of skin | 1 4 |
| 5 Crepitation | 2 8 |

(Largest swelling 12 by 12 cm. Smallest swelling 3 by 3 cm. Average size 6 by 6 cm.)

and an attempt is made to coaptate the walls of the sac by firm and reinforced adhesive strapping. A pressure bandage is then applied over the knee so that the patient must walk with the knee in complete extension. Usually the patient has very little discomfort from these procedures. In about half the cases the dressings can be removed in from 5 to 7 days without further treatment. In the remaining cases there is reaccumulation of fluid in a few days to such an extent that reaspiration is necessary in about half of them. The strapping, and the pressure bandage are continued. A second injection of tincture of iodine is usually not necessary.

| Aspirated fluid ¹ | | Cases | Per cent |
|----------------------------------------------------------------|--|----------------|----------|
| A Character | | | |
| Bloody | | 11 | 64 |
| Yellow | | 5 | 24 |
| Amber | | 2 | 8 |
| Pel brown | | 1 | 4 |
| Not recorded | | 8 | 29 |
| B Culture of aspirated fluid | | 11 negative | |
| 1 (Largest amount 50 c cm. Smallest amount 3 c cm. 10 5 c cm.) | | Average amount | |
| Treatment | | Cases | Per cent |
| a Iodine injected | | 23 | 90 |
| Average amount 4.5 c cm. | | | |
| Average strength 3.5 per cent | | | |
| b Injection pure carbolic | | 1 | 5 |
| 10 minims | | | |
| c Injection phenol 1:200 | | 1 | 5 |
| Course after treatment | | Cases | Per cent |
| a Number of cases in which fluid reaccumulated | | 16 | 60 |
| b Length of time after first aspiration | | | |
| Longest 42 days shortest 2 days | | | |
| Average 10.4 days | | | |
| c Type of fluid | | | |
| Not known or not recorded | | 10 | 63 |
| Red (serosanguineous) | | 4 | 25 |
| Brown | | 1 | 6 |
| Straw | | 1 | 6 |

| Treatment of reaccumulated fluid | | Cases | Per cent |
|------------------------------------------|--|-------------|-------------|
| Aspiration | | 5 | 31 |
| Aspiration plus iodine (3½ per cent) | | 3 | 19 |
| Aspiration plus carbolic (pure—10 drops) | | 1 | 6 |
| No treatment | | 7 | 44 |
| Total number of cases in analysis | | 27 | |
| Total number of follow up cases | | 24 | |
| a Follow up time | | | |
| Shortest follow up | | (1.4 month) | 7 days |
| Longest follow up | | | 108 months |
| Average follow up | | | 16.3 months |

Although a satisfactory end result might have been obtained in some of these cases without any treatment, the eventual complete disappearance of bursal fluid and of symptoms seems to justify the therapy as described.

SUMMARY

1 Twenty seven consecutive acute or chronic cases of prepatellar bursitis ("house maid's knee") were studied to determine the end results of conservative therapy. This consisted in aspiration of the fluid, injection of several cubic centimeters of half strength tincture of iodine into the sac, vigorous massage over the bursa, reinforced adhesive strapping over the sac with the knee in complete extension, and the application of a firm pressure bandage over the knee.

2 The cases were preponderant in housewives



Fig 3 Low power photomicrograph through one of the red papillary projections shown in Figure 2 The wall is dense and fibrous The projection stands out because of the presence of a large number of capillaries surrounded by a more cellular fibrous tissue (Courtesy of Dr A P Stout)

3 About 65 per cent of the patients gave a history of trauma

4 About one-third of the cases complained of pain

5 Swelling of the bursa appeared either immediately after the trauma or after days, weeks, or months

6 The character of the aspirated fluid depended on the length of time it took for accumulation In the early cases it was bloody, in the later cases amber or straw-colored

7 Aerobic and anaerobic cultures in 11 cases were sterile

8 In a little more than half the cases small amounts of fluid reaccumulated in an average time of 10 days Aspiration of this fluid was employed A second injection of tincture of iodine in these cases was usually not necessary

9 An average follow-up of 16 months in 24 out of the 27 cases showed no symptoms or re-appearance of bursal fluid In 20 of the 24 follow-up cases the average time for complete disappearance of the fluid was about 3 weeks

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BILIARY TRACT VISUALIZATION WITH RADIOPAQUE OILS¹

RICHARD H. OVRHOLT, M.D., PHILADELPHIA

From the Surgical Division B and the Department of Roentgenology of the Hospital of the University of Pennsylvania

THE use of radiopaque solutions to define the biliary ducts after a drainage operation has proved of sufficient value during the past year to warrant the publication of the results of such a procedure.

The value of exact information concerning the size, contour, and the patency of the cystic or common duct following cholecystectomy or of the common and hepatic ducts following choledochotomy need not be emphasized. Following such operations, there is frequently an uncertainty about underlying pathology, overlooked stones or the extent of trauma to the biliary ducts. The more limited the exploration at the time of operation the greater this uncertainty.

A definite knowledge of the patency of the biliary duct system is required in the proper postoperative management of the case, such as the determination of the time for withdrawal of the T tube, and in giving a prognosis as to the probability of a persisting biliary fistula. The determination of obstruction of the common duct before the T tube is withdrawn is also important if a second operation is required, as the common duct is more easily located if the T tube is left in situ.

There are various indirect ways of gaining information about the condition of the common biliary duct after operation. The measurement of the external drainage during a given period of time and its subtraction from the estimated total biliary output indicates the amount of the internal drainage. Macroscopic and chemical examination of the stools for bile pigment, as well as the disappearance of jaundice, and the improvement in the Van den Bergh reaction, all are used to determine common duct patency. The ability to clamp the T tube without causing discomfort, an increase in jaundice or in the Van den Bergh reaction or a leak about the tube in the wound is generally taken as sufficient indirect evidence to say that the common duct is patent.

However, in some patients these criteria are not reliable. Especially is this true in patients in whom there has been some hepatic drainage with a suppression of biliary output. The external drainage may be small, the stools light, and the jaundice slow in clearing, yet the common duct may be patent. On the other hand, indirect evidence may readily suggest that there are present

a normally functioning ampulla and a partial occlusion.

On the service of Dr. George P. Muller, we have found that in a certain number of postoperative biliary cases, a roentgenological study during the injection of a radiopaque solution is of distinct value. Twelve such examinations upon eleven different patients were made.

Lipiodol injections of chronic biliary fistulae have been carried out and the diagnostic importance of such a procedure pointed out by Piccinino and Pajenzia, Caeiro, and by Ginzburg and Benjamin. There are fewer reports of the use of such a procedure in securing information about a case after operation before the T tube has been removed. Cotte, however, has emphasized the value of the visualization of the biliary tract with the T tube in place.

METHOD

During the second or third week after operation, the patient is placed on an adjustable fluoroscopic table. The gall bladder drainage tube or common duct tube is then injected with the opaque material, under fluoroscopic control, the amount varying from 15 to 20 cubic centimeters, depending upon the manner in which the biliary system fills. No force is required to make the injection as the solution will practically run into the ducts by the force of gravity.

We found campidol (iodized ripe seed oil) to be a safe and satisfactory visualizing medium. This substance was introduced by Frazier and Glaser for use in cerebrospinal visualization. Later Frazier pointed out the advantages of campidol for general use in roentgenological exploration. In a few patients we used brominol, a brominated olive oil. Satisfactory visualization was obtained without evidence of tissue irritation. Brominol has the advantage of being less expensive than the other radiopaque oils. Sodium iodide was tried but the flow of this solution was more difficult to follow fluoroscopically.

When a complete or partial obstruction of the common duct was noted, the drainage tube was clamped following the injection and fluoroscopic examinations made at intervals over a period of 30 to 40 minutes. In some a duodenal tube was passed, and a solution of magnesium sulphate was injected.





Fig 3 Appearance when common duct is patent. Roentgenogram made 2 weeks after cholecystectomy and choledochostomy. Note poor visualization of hepatic ducts and the presence of most of the campidol in the jejunum. T, Drainage tube; H, hepatic ducts; D, campidol in duodenum; J, campidol in jejunum.

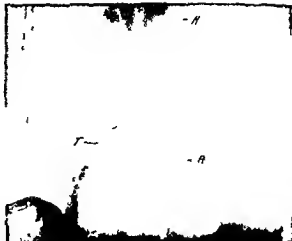


Fig 4 Roentgenogram made 2 1/2 weeks after cholecystectomy and choledochostomy. Note dilatation of biliary ducts with obstruction at ampulla. Only an occasional drop of campidol passed into the duodenum. T, Drainage tube; H, dilated hepatic ducts; A, obstructed ampulla.

the Van den Bergh reaction, and the duration of the convalescence.

CASE 8. Mr. J. E. P., aged 33 years, admitted to hospital December 30, 1929 (Fig. 1). There were symptoms of gall bladder disease of 2 months and jaundice of 1 month's duration. After a 4 day preparation patient was operated upon by Dr. G. P. Muller. A subacute cholecystitis was found. A cholecystectomy and choledochostomy were done. Several drams of gravel were removed from the dilated common duct. Following operation the jaundice disappeared very slowly. Three weeks after operation a Van den Bergh test showed a biphasic direct reaction and 1.6 units by the indirect test. Drainage from the common duct tube varied from 450 cubic centimeters to 1,010 cubic centimeters for each 24 hours. The stools were light in color for 2 weeks then became darker and bile pigment could be found in the faeces. Clamping the common duct tube was tolerated fairly well by the patient although epigastric distress occurred at times.

Three weeks after operation campidol was slowly injected into the common duct with the patient under the fluoroscope. The opaque medium entered the common duct and hepatic ducts immediately. These ducts were dilated. None of the oil entered the duodenum. Frequent peristaltic waves in the common duct forced the oil farther up the hepatic ducts. The tip of the Rehfuess tube previously passed was found in the stomach and attempts to have the tube enter the duodenum failed. Fifty cubic centimeters of a 50 per cent solution of magnesium sulphate was injected into the Rehfuess tube however and no effect on the oil in the common duct was noted. The patient was under observation for a period lasting 40 minutes. The patient was discharged and requested to return to the follow up clinic every 2 weeks. Operation to be advised if pattern of the common duct did not re establish itself in a reasonable period of time.

In this patient the injection of oil into the common duct established definitely the fact that an obstruction still existed. The removal of the com-

mon duct T tube was advised against as a biliary fistula would certainly follow and the drainage be less conveniently handled. The dilated hepatic ducts were an additional factor in this case which suggested marked liver damage due to prolonged ductal obstruction.

CASE 9. Mrs. R. B., aged 36 years, admitted to hospital August 30, 1929 (Fig. 2). A history referable to gall bladder disease antedated the patient's admission by 13 months. A cholecystectomy had been done 5 months previously. Attacks of pain reappeared 3 months ago and were associated with jaundice. The physical examination revealed nothing unusual except those findings associated with the common duct obstruction. The Van den Bergh reaction showed a direct biphasic and an indirect test of 12 units. The icteric index was 100. After the usual preparation, the patient was operated upon by Dr. Muller and an obstruction of the common duct due to a cicatrix was found about 3 centimeters above the ampulla. No stones were located. A T tube was inserted.

Convalescence was quite uneventful. Drainage from the T tube varied from 600 to 1,200 cubic centimeters daily and the jaundice decreased slowly. Nine days after operation the common duct tube was injected with campidol under fluoroscopic visualization. The oil went into the duodenum rather sluggishly, and the common and hepatic ducts filled fairly well.

The amount of drainage continued to be 600 to 700 cubic centimeters for each 24 hour period. Continual clamping of the common duct tube caused some distress. For these reasons and because the emptying of the common duct was sluggish as visualized roentgenoscopically the T tube was left *in situ*, and the patient was advised that it could be removed in 6 weeks. This was done and the sinus closed rapidly.

In this case, roentgenoscopic visualization of the biliary system substantiated the indirect evidence that a free flow of bile into the duodenum



Fig 5 Biliary tract injected with campiodol 7 days after operation. Note poor visualization of hepatic or common ducts. The oil went almost immediately into the duodenum where a large portion of it can be seen. The relation of the common duct to the duodenum is clearly seen. Note that some of the campiodol is in the jejunum. *H*, Hepatic ducts, *C*, common duct, *D*, campiodol in duodenum, *T*, drainage tube, *J*, oil in jejunum, *R*, jutte tube in duodenum.



Fig 6 Roentgenogram made after cholecystectomy drainage tube had been injected with 20 cubic centimeters campiodol. The gall bladder and right hepatic ducts are well visualized. No trace of oil can be seen in upper intestinal tract. *H*, Hepatic ducts, *GB*, gall bladder, *T*, drainage tube.

was not taking place. For this reason withdrawal of the T-tube in the common duct was delayed.

CASE 7. Mrs. R. E. G., aged 59 years, was admitted to hospital March 1, 1930 (Fig. 4). She had been seriously ill for a week with chills, fever, jaundice, and pain in the upper right quadrant. A diagnosis of acute cholecystitis was made and operation was delayed for 5 days until a subsidence of symptoms occurred. A cholecystectomy and choledochotomy were done. The general condition of the patient improved, the jaundice cleared slowly, the Van den Bergh values decreased, and occasionally the stools were dark in color. The external drainage varied from 100 to 400 cubic centimeters in a 24 hour period. Two and one half weeks after operation the T tube was injected with 20 cubic centimeters campiodol under the fluoroscope. The oil immediately filled the common and hepatic ducts. Only an occasional drop could be seen passing into the duodenum. The hepatic ducts were greatly dilated. The patient was later discharged with the T tube in place. She returned after 2 months. The biliary tract was again visualized roentgenoscopically. The same dilated hepatic and common ducts with almost complete obstruction at the ampulla were found. Reoperation was recommended and choledochoduodenotomy was carried out with the T tube still in place until the common duct was isolated. The patient made an uneventful recovery.

In this case a definite obstruction at the ampulla was determined early, the drainage tube left in place, and the external drainage conveniently handled until a second operation could be



Fig 7 Roentgenogram made after campiodol was injected in a cholecystostomy drain. This patient had an acute cholecystitis. Exploration was impossible. The injection demonstrated complete common duct obstruction. One of the drainage tubes is beneath the gall bladder. *H*, Hepatic ducts, *GB*, gall bladder, *C*, common duct, *T*, drainage tubes.

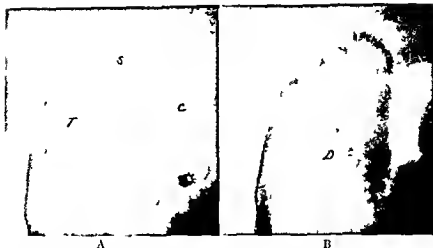


Fig 8 Roentgenograms made after brominal injection of cholecystostomy drain T. This patient had an acute cholecystitis and pancreatitis. No obstruction found. Note spiral appearance of cystic duct S. Common duct C is well visualized. A Before ampulla opened. B during flow of oil into duodenum D.

safely performed. The early withdrawal of the T tube would have made the location of the common duct more difficult at the second operation.

CASE 5. Mr J. McK., aged 55 years, was admitted to hospital September 23, 1929 (Fig 5). The history referable to gall bladder disease dated back 8 months. Following a severe attack of upper right quadrant pain 6 weeks previously the patient had become jaundiced. There was nothing unusual in the physical examination or laboratory tests other than those associated with a deep jaundice. At operation Dr. Muller found a cicatricial stenosis of the common duct but no stones were present here or in a subacutely inflamed gall bladder. A cholecystectomy was done and the common duct drained. Convalescence was uneventful. The amount of biliary drainage averaged 100 cubic centimeters in each 24 hour period. The jaundice rapidly disappeared. Seven days after operation the common duct was injected with campidol under the fluoroscope. The opaque oil went into the duodenum from the common duct. The remainder of the convalescence was uneventful. On the sixteenth day after operation the T tube was removed and the biliary fistula quickly closed.

In this case the drainage was very slight, the jaundice cleared rapidly and the stools assumed a normal color early in the convalescence. All of these factors indicated a patent common duct. The direct visualization of the ducts substantiated the indirect evidence of common duct patency.

CASE 4. Mrs M. M., aged 43 years, was admitted to the hospital July 6, 1929 (Fig 6). This patient had had epigastric distress and nausea for 8 months. Jaundice appeared 1 month before she entered the hospital and was progressively increased in severity. After a 4 day period of preparation the patient was operated upon by Dr. George P. Muller. A carcinoma of the head of the pancreas was found. Only cholecystostomy was done because of the poor condition of the patient and technical difficulties in mobilizing with the stomach or duodenum for anastomosis.

Following operation the jaundice cleared very slowly; the drainage varied from 100 to 400 cubic centimeters for each 24 hour period and the stools remained a putty color. Four weeks after operation campidol was injected into the gall bladder via the drainage tube. Under the fluoroscope rhythmic contractions of the gall bladder could be seen. These were not influenced by the respiratory movements and were present when the patient held her breath. The opaque oil passed into the common duct and was regurgitated up into the hepatic ducts. Occasionally drops of oil could be seen passing through the ampulla and into the duodenum. The patient's general condition failed to improve enough to warrant completing the second stage of the operation. She was discharged with the tube *in situ* and died 5 months later after a rapid extension of the carcinoma.

From the standpoint of gaining information which could be applied in the management of this case, little was obtained by the use of the opaque injection. However, we were able to see rhythmic contractions of the human gall bladder which have never before been demonstrated.¹

CASE 11. Mrs M. McG., aged 61 years, was admitted to the hospital February 2, 1930 (Fig 8). This patient had had symptoms referable to the gall bladder for 5 months and during the past 2 months jaundice was associated with the attacks of pain in the right upper quadrant. The patient was treated in the medical ward for 12 days and was then transferred for surgery. At operation Dr. C. I. Muller found an acute calculous cholecystitis and an acute pancreatitis. Further exploration was decided against and a cholecystostomy was done. Convalescence was uneventful. The jaundice subsided rapidly. Drainage from the gall bladder amounted to 500 cubic centimeters the first 24 hours and then decreased to about 100 cubic centimeters in each 24 hours. Two weeks after operation, campidol was

¹This fluoroscopic observation was made in the presence of Dr. I. S. Ravdin and Dr. E. P. Pennington. See I. S. Ravdin's Observations on the Contractions of the Gall Bladder. Ann. Surg. to be published.

injected into the gall bladder via the drainage tube. The opaque media passed immediately through a tortuous cystic duct into the common duct, which filled completely. No defects in the contour of the common duct were noted, and periodically the ampulla opened and the opaque solution passed rapidly into the duodenum. On the day following this test of the patency of the common duct, the tube within the gall bladder was removed, the fistula closed, and the wound healed. The patient was discharged on the twentieth day after operation.

In this case it was impossible and unwise to palpate or open the common duct, yet there was a history of jaundice. The injection of an opaque solution into the biliary system showed definitely the absence of stones in the cystic or common duct and a patent ampulla. With such information we were able to remove the drainage tube immediately and to advise the patient that a biliary fistula would not result.

SUMMARY

The use of a radiopaque oil for roentgenoscopic exploration after biliary tract operations has a definite value in the determination of common

duct patency. No untoward effects following such a procedure were noted.

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OVARIAN PREGNANCY

RICHARD P. CRAWMER M.D. F.A.C.S., MINNEAPOLIS, MINNESOTA

OVARIAN pregnancy was first described in the 17th century, by Mercurius and St. Meurice, and its possibility was generally conceded until 1835 when Velpeau stated that none of the cases which had been described up to that time afforded conclusive evidence of ovarian origin. Similar views were expressed by Mayer in 1847. This skepticism was probably justifiable, since most of the early cases collected were simply dermoid cysts of the ovary.

With the exception of Mayer, the possibility of ovarian pregnancy has always been admitted by the German writers, but was strenuously denied until 1901 by the English authorities, particularly by Tait, Webster, and Bland Sutton.

Williams states that as far as he can ascertain, only 3 cases were reported in England during the 19th century. In this country most writers have followed the English authorities, although Pairy admitted its existence and not a few operators had reported doubtful cases, but it was not until 1902 that Thompson demonstrated a conclusive specimen.

Up to 1878 there existed no definite criteria by which specimens could be judged, and many were described as examples of ovarian pregnancy which had no claim to such a title. In that year, however, Spiegelberg formulated certain criteria which he held must be fulfilled in order to justify such a diagnosis. He demanded (1) that the tube on the affected side be intact, (2) that the fetal sac occupy the position of the ovary, (3) that it be connected with the uterus by the ovarian ligament, (4) that definite ovarian tissue be found in its wall. When judged by these criteria, the majority of cases which had been described up to his time were wanting, and subsequent investigation has shown that a number of cases which he considered conclusive are likewise open to very considerable doubt.

Now the possibility of ovarian pregnancy is universally admitted, and even so rigorous a critic as Webster has abandoned his skepticism, and has reported two authentic cases.

Williams also said he had carefully gone over the literature upon ovarian pregnancy, and has classified the cases reported up to January, 1906, as positive, highly probable, fairly probable, and doubtful, according to the extent to which Spiegelberg's criteria were fulfilled. He was

able to find 13 specimens belonging to the first category, which were thoroughly described, and so carefully studied microscopically that their ovarian origin was conclusively demonstrated; namely, the cases of Gottschalk, 1893; Ludwig, 1896; Kowser and Tussenbroek, 1899; Croft, 1900; Anning and Littlewood, 1901; Robson, 1902; Frinz, 1902; Thompson, 1902; Mendes De Leon and Holleman, 1902; Micholitsch (2 cases), 1903; Roesbeek, 1904; and Webster, 1904. The patients of Gottschalk and Ludwig had gone to term but in none of the other 11 had the pregnancy progressed beyond the fourth month. Since then many more positive cases have been described. Lockyer reported 2 personal cases in 1917. Meyer and Wayne have since reported an additional case and analyzed the literature up to 1919.

It is interesting to note that in one third of the positive or highly probable cases which Williams collected, the pregnancy had gone to full term, and in several instances had eventuated in the formation of lithopædia which had been carried for years before being removed. This would appear to indicate that the ovary can accommodate itself more readily than the tube to the growing pregnancy, but rupture at an early period is the usual termination.

Probably a great number of specimens come to the pathologist at a time when the pregnancy is advanced and the anatomical relations are so distorted by the fetal sac that it is difficult to make the specimen fulfill all of the requirements for establishing the diagnosis. It is, therefore, very hard to determine how commonly ovarian gestation occurs. It is the author's opinion that ovarian hematomata are, in a number of instances, ovarian pregnancies.

Lewis' *System of Surgery* states that up to the present time only 45 cases of undoubted ovarian pregnancy have been reported. There is nothing in the history or examination to differentiate between ovarian and tubal pregnancy except that in the ovarian type the pregnancy usually advances further.

In ovarian, as in tubal gestation, very little decidua is found and when rupture occurs it is usually caused by the invasion of the syncytium into the wall of a blood vessel causing hemorrhage which overdistends the sac wall. Severe or fatal hemorrhage into the peritoneal cavity may take



Fig. 1 Photograph of gross specimen laid open showing sac occupying the central area of the ovary

place when rupture occurs or bleeding may be slight and the process go on to resolution

On reviewing the literature on this subject we find that there have been 9 cases reported since 1925. Four of them were reported in British medical journals, 3 in German, and 2 in American medical journals

Among the recent cases of ovarian pregnancy appearing in British medical journals is one by Franzen and R S S Statham, of the Bristol Royal Infirmary. This was reported in 1927. Their patient was operated on after skipping a second menstrual period and an embryo of 7 millimeters was found in a sac containing a clear fluid. This case appears to be a true ovarian pregnancy, as the historical examination revealed the presence of embryonic tissue surrounded by ovarian tissue and the tube on the affected side was intact

Another case of ovarian pregnancy was reported by W W King in 1926 in the *Journal of Obstetrics and Gynaecology of the British Empire*. The microscopic photographs proved the presence of embryonic tissue close to which could be seen corpus luteum. The ovary retained its anatomical relationship with attachments to the uterus and broad ligament. The left fallopian tube which was normal was quite separate and not adherent to the ovary

Another case was reported in 1926 by Acomb and Canby which was a full time ovarian fetation. This patient was 33 years old, had been married 6 years, and had not heretofore become pregnant. The patient appeared to be about 8½ months



Fig. 2 1, Follicle, 2, villi, 3, hemorrhage, 4, chorionic membrane, 5, corpus luteum, 6, ovarian tissue

pregnant at the time of the first examination. On X-ray examination there appeared to be a fully developed fetal skeleton lying in an extremely irregular position. The head was above the pelvis and the fundus above the crest. The fetal spine formed an acute angle against the abdominal wall of the mother. The skeleton appeared to lie in a more ventral position than normal. On operation the uterus itself was found in the pelvis and was slightly enlarged. The right fallopian tube was stretched over the sac, and the tissue of the right ovary was thinned out, and constituted the outer layer of the sac. The sac lay above the broad ligament. A full time male child weighing about 7½ pounds was delivered through the incision. The skin was slightly macerated. The child appeared to have been dead for 2 or 3 weeks.

In 1928, a report of ovarian pregnancy appeared in British literature and was reported by Banister J Bright. The patient was admitted as one of a right pyosalpinx. She had skipped one menstruation. Her symptoms corresponded to the usual symptoms of ectopic pregnancy. On examination a mass was felt to the right of the uterus. Microscopically the specimen appeared to be one of ovarian pregnancy. The four criteria stated by Spiegelber appeared to have been fulfilled.

Barna reported a case in 1925 which presented the usual symptoms and signs of ectopic pregnancy. This patient developed abdominal hemorrhage that necessitated immediate operation and the left ovary was found to be enlarged and bluish in color. Grossly and microscopically the specimen appeared to be one of ovarian pregnancy.

Zimmerman, of Germany, reported a case of ovarian pregnancy in June, 1927, which appeared to be one almost identical to the one reported by Barna. There was a rupture of the ovarian tissue and hæmorrhage which necessitated immediate operation. Microscopic examination showed it to be a case of true ovarian pregnancy.

Hellendall, of Germany, reported a case of ovarian pregnancy in November, 1927. His patient had had a miscarriage a year before. Eight days after cessation of her menstruation she experienced severe pains on the left side and slight bleeding. On examination a mass could be felt at the left of the uterus. Diagnosis of ectopic pregnancy was made and operation showed it to be a true ovarian pregnancy.

Among the recent reports in American literature we find one by R. M. Wayne, in 1926. His patient presented the usual symptoms and signs of ectopic pregnancy but it was unusual in that it progressed to a late stage. His patient last menstruated December 23, 1922, and she was operated upon June 30, 1923, at which time a living male child of approximately 27 weeks was extracted. The child lived 10 hours. Macroscopically the structure showed a sac occupying the position of the right ovary and adhesions to sections of the small intestines, sigmoid, uterus, and pelvic floor. The right tube was normal except for the great increase in length. The utero ovarian ligament, although adherent to the mass, could be seen. The microscopic section of the sac showed a developed ovarian tissue.

James R. Manley reported a case of ovarian pregnancy in 1926. She too presented the usual signs of ectopic pregnancy. The specimen removed was the left ovary containing a hamatoma about $1\frac{1}{2}$ inches in diameter. The tube on the infected side was intact. The specimen on microscopic examination showed ovarian tissue and a large area of corpus luteum. The embryo itself was a centimeter in length.

A brief report of our case follows.

Mrs. W. M. aged 32 years. The family history was negative. She had had the usual diseases of childhood but no serious illness or any operations. Menses began when she was 13 years old, had always been regular and appeared every 28 days, lasting 8 days. She gave no history of dysmenorrhea. She had been pregnant twice before and had gone on to normal deliveries. Her last child was born 5 years ago. She gave no history of pelvic infections.

Present illness—physical findings and operation. Patient was first seen February 17, 1929, at which time she complained of indefinite pain in the left pelvis. She had started menstruating February 10 in a normal manner except that she experienced some slight cramps on both sides. Examination revealed a temperature of 100 degrees F. and a pulse rate of 84. A mass about the size of a lemon

could be felt to the left of the uterus. This mass was not adherent to surrounding structures. The leucocyte count showed 13,000 red cell count 3,800,000 and hæmoglobin 80 per cent. There had been no bleeding. Extra uterine pregnancy was considered but that diagnosis was discarded as patient had never missed a menstruation and the mass was freely movable. There was no nausea and no breast signs. There was, however, a slight uterine enlargement but the cervix seemed normal. The diagnosis of ovarian cyst seemed the most reasonable and it was thought that it was possibly twisted on its pedicle causing tenderness, slight fever and an increased leucocyte count. The patient was watched for 2 days during which time the pains in the left pelvis became more severe. She was sent to the hospital and operated upon the following day. The mass in the left pelvis was found to be a bluish gray mass occupying the position of the ovary and was attached to the uterus by the utero ovarian ligament. The tube on that side was intact and appeared to be normal. The mass was not adherent to any structure. It was removed and the abdomen closed. The patient made an uneventful recovery.

On opening the specimen a sac was found within containing a clear fluid and a gray membrane resembling placental tissue. A small grayish body suspended on a pedicle was seen. A section of the placental tissue was sectioned and stained and examined under the microscope. Chorionic villi were demonstrated by their layers of syncytial and Langhans cells. The gross specimen was sent to Dr. George Streeter, director of the embryology department of the Carnegie Institute. His report is as follows:

I am enclosing photographs of your specimen which prove very conclusively the specimen to be one of ovarian pregnancy. In the photographs one can clearly recognize the corpus luteum, graafian follicles and typical ovarian tissue embedded in which is the ovum with normal appearing chorion and chorionic villi. The photograph of the gross slide laid open in the midline gives the appearance of the total chorionic sac occupying the central area of the ovary. Around the tips of the villi there is more or less extravasation typical of implantation areas.

All of Spiegelberg's criteria were fulfilled in this case. The tube on the affected side was intact, the sac occupied the position of the ovary, it was connected to the uterus by the utero ovarian ligament, and ovarian tissue was found completely surrounding the sac.

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SUBMUCOUS LIPOMATA OF THE GASTRO-INTESTINAL TRACT

REPORT OF TWENTY-FOUR CASES¹

MANDRED W COMFORT, M D, ROCHESTER, MINNESOTA
Division of Medicine The Mayo Clinic

BENIGN tumors of the gastro intestinal tract arouse interest because of their comparative rarity. They deserve careful consideration because of the excellent prognosis following excision and the less radical surgical procedure which often can be adopted if they are recognized before operation or at the time of operation.

The observation recently at the clinic of a lipoma of the ascending colon, producing obstructive symptoms, renewed my interest in that subdivision of benign gastro-intestinal tumors. A study was made of this, as well as other cases occurring at the clinic, of those cases described by other authors, and of the pathological material, both that obtained at operation and at necropsy. The importance, as well as the absence of a comprehensive review in English, of this group of tumors since 1909 encouraged me in the idea of presenting in abstract reports of cases that have been published and of those which have occurred at the clinic.

Lipomata of the gastro-intestinal tract are divided anatomically into two groups the submucous and the subserous. A small number are both submucous and subserous. The submucous variety is more common. The not uncommon development of subserous lipomata from appendices epiploicae, and the origin of symptoms from the size and weight of the tumor (as well as from the difference in situation) makes it advisable that the two groups be considered separately, from the clinical and pathological, as well as from the anatomical, standpoints. It has seemed expedient to confine the present review to the submucous group.

The submucous lipomata which have been observed at the clinic can be divided into two groups. Group 1 is composed of those tumors which produced symptoms. They are four in number. One of these, a gastric lipoma, has been reported recently by White and Judd, and the case will not be reported here. The 3 remaining tumors were in the large bowel. One of these (Case 1), a lipoma of the sigmoid mentioned briefly by King, is of sufficient interest to warrant a complete account of the case. Group 2 is composed of 25 tumors which did not produce symptoms, one mentioned by King, which was observed incidentally at operation, has been included, the 24 others were found in the course of 3,924 consecutive necropsies.

REPORT OF CASES IN GROUP 1

CASE 1 A man aged 54 years, registered at the clinic, September 25, 1914 complaining of bowel trouble. The family history and remote personal history were unimportant. Six years previous to registration, for a period of 2 months, there had been constipation, alternating with diarrhea, and soreness in the left lower quadrant of the abdomen. When he had been constipated, there had been a palpable mass in the left lower quadrant, the mass had disappeared following the action of a cathartic. The diarrhoeal stools had contained blood and mucus. No further trouble had occurred until 3 months before registration, when there had been griping pains in the lower part of the abdomen, a sense of obstruction in the left lower quadrant, and stools composed largely of mucus with some blood. During the last week before admission there had not been any bloody mucus.

The systolic blood pressure was 156 and the diastolic 116, measured in millimeters of mercury. There was a somewhat movable, ridge like mass 15 to 20 centimeters long in the left lower quadrant of the abdomen. Examinations of urine, blood, and stool, and proctoscopic examination gave negative results. Roentgenological examination



Fig 1 Lipoma of the sigmoid. Infolding of the muscular layer into the angle between the mucosa and the lipoma is evident. The base is covered by the thinned muscularis and the free portion by the necrotic mucosa. Case 1.

after a barium enema disclosed an obstruction in the descending colon. A diagnosis of carcinoma of the sigmoid (70 per cent) and diverticulitis (30 per cent) was made.

Abdominal section September 30, 1914, revealed that intussusception had been present and had been reduced spontaneously before operation. A mass was palpated in the upper part of the sigmoid. Resection of 25 centimeters of the sigmoid and an end to end anastomosis were performed.

Examination of the specimen removed at operation revealed a tumor measuring 5 by 4 by 3.5 centimeters which was attached near the line of reflection of the mesentery by a base measuring 2.5 centimeters in diameter. The mucosa reflected over the tumor was normal in appearance for a distance of 1.5 to 1.7 centimeters. The remaining lobulated surface of the tumor was covered by a bluish yellow smooth layer. Dissection of the thickened subserosa revealed as seen on cross section an elevated yellow area surrounded by a groove which separated it from the muscular layers of the wall of the bowel. The tumor was composed of soft yellow tissue, arranged in lobules separated by narrow bands of more dense and opaque tissue and discolored immediately underneath the necrotic portion of its surface. The microscopic section (Fig. 2) showed the reflection of the mucosa muscularis mucosae and submucosa over the surface of the tumor. The mucosa was normal except for the zone of transition which was interposed between the normal mucosa and the necrotic portion. The necrotic portion was composed of fibrin and it held in its meshes dense masses of disintegrating leucocytes. The muscularis



Fig 2 Submucous lipoma of the ascending colon. Case 3.

muscosae was traced as a distinct bundle for about half the distance from the wall of the bowel to the level of the zone of transition. The muscular layer was thickened at the level of the bottom of the groove surrounding the base of attachment and it could be traced in the one direction over the base of attachment of the tumor as a thin layer. In the other direction it was continuous with the muscular layers of the wall of the bowel forming the outer wall of the groove along the surface of the tumor. The fibers decreased in number to a point a third of the distance between the wall of the bowel and the region of mucosal replacement. At the level of mucosal disintegration muscle fibers were no longer recognized. In addition to the connective tissue, capillary numerous capillaries and a few arteries with supporting stroma were present. In the region beneath the necrotic membrane patches of cells chiefly erythrocytes with an occasional leucocyte were present in the supporting stroma.

Convalescence was uneventful. June 19, 1915, the patient stated by letter that aside from constipation and a small postoperative ventral hernia, he was in excellent health.

The obstructing nature of the lesion was apparent. The early history of distress in the left lower quadrant, could it have been proved to be a result of the lesion which was causing trouble at the time of examination, would have pointed to a non malignant process of long duration. Diverticulitis, or a carcinoma, might have caused the more recent symptoms. The age of the patient and loss of weight are compatible with each. The rarity of intussusception, and the lack of distinctive features, justified hardly more than passing consideration of this possibility. The more justifiable assumption was that carcinoma was present.

CASE 2. A woman aged 39 years entered the clinic June 30, 1926, complaining of severe attacks of pain in the upper part of the abdomen. The family history, remote personal history, and menstrual history were unimportant. One year previous to examination bloating and epigastric distress after meals made it necessary for her to avoid heavy foods, meat and cabbage. Two months before she registered at the clinic during an attack of influenza the



Fig 3 Large submucous lipoma of the greater curvature of the stomach. Case 5.



Fig. 4 Cross section of a small lipoma attached by a short fibrous pedicle to a plica circularis of the jejunum Case 12 (Hæmatoxylin and eosin, $\times 5$)

first attack of severe pain had occurred. There had been two attacks since, the last, 2 weeks before registration. The pain was in the right part of the epigastrium and spread to the lower part of the abdomen and through to the back. The last attack had lasted 5 days during which time she had vomited constantly a greenish, bitter fluid, and had been obstinately constipated.

The patient's height was 61.5 inches, her usual weight was 130 pounds and her weight at the time of examination was 105 pounds. Blood pressure, pulse rate and temperature were normal. There was a large, firm mass in the right side of the abdomen, in the region of the ascending colon. The mass was movable. Examination of the urine and blood, and the Wassermann reaction of the blood gave negative results. Roentgenological examination after a barium enema revealed a large filling defect at the hepatic flexure and marked obstruction. A diagnosis of carcinoma of the colon at the hepatic flexure was made.

The specimen obtained at operation was a cup shaped section of large bowel, one side of the cup was cut away to display the tumor. The thickened oedematous condition of the wall of the bowel incident to circulatory changes wrought by the operative procedure was striking. The tumor was cauliflower shaped. It measured 7.5 by 3.5 centimeters and extended 4.5 centimeters into the lumen of the bowel. Its base of attachment measured 4.5 by 2 centimeters. It was composed of yellow tissue arranged in irregular lobulations and was covered completely by normal mucosa. In microscopic section were seen normal mucosa, submucosa, and muscularis mucosae reflected from the wall of the bowel over the tumor, and infolding of the muscular layer for a short distance in the area between the reflected mucosa and the surface of the tumor. The microscopic structure of this tumor was similar to that in Case 1. In addition, oedema, cellular infiltration and great thickening of the wall of the bowel, especially of the subserous layer, were present.

September 23, the opening made at colostomy was finally closed after curettage. In January 1927, the patient's general condition was excellent. A small, pin point opening remained at the site of colostomy.

None of the features of the case pointed to the benign nature of the obstructive lesion. The preponderance in incidence of carcinoma of the colon over all other tumors of the colon as a cause of obstruction made reasonable the assumption that a carcinoma was obstructing the bowel.



Fig. 5 Section through the periphery of the lipoma. The intra intestinal pressure has caused the serosal surfaces overlying the tumor and the surrounding wall of the bowel to touch, and has produced an arrangement of the muscle layers suggesting infolding, an earlier stage of that seen in Figure 1. Case 20 (van Gieson's stain, $\times 8$)

CASE 3. A woman, aged 43 years, was referred to the clinic, November 30, 1928 because of epigastric pain and a round firm mass 10 centimeters in diameter and slightly movable in the left upper part of the abdomen. The family, marital, and menstrual histories were negative. There had been distress high in the epigastrium for a number of years, at irregularly occurring periods. During the last month before registration at the clinic severe epigastric pain, more severe between meals, had been present at times, the patient had vomited every 2 or 3 days, constipation had appeared at the onset. Diarrhoea had occurred for one day. Blood had not been present in the stools.

There was a large, rounded, apparently smooth, moderately movable, and slightly tender mass in the left side of the abdomen at the level of the umbilicus. Examination of the urine, and the Wassermann reaction of the

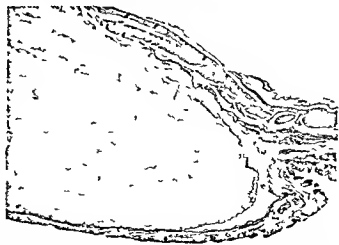


Fig. 6 A cross section showing the typical lipomatous structure of the tumor, its submucous situation, and the displacement of the muscularis peripherally as well as of the mucosa centrally. Case 23 (van Gieson's stain, $\times 12$)

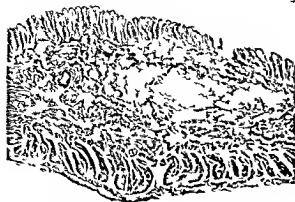


Fig 7 A small collection of fat cells in the submucosa Case 26 (Hematoxylin and eosin, $\times 12$)

blood gave negative results. The concentration of haemoglobin was 40 per cent, erythrocytes numbered 4 700 000 and leucocytes 9 700 in each cubic millimeter of blood. The differential count was negative. Roentgenological examination of the thorax gave evidence of healed lesions of tuberculosis of the upper lobe of the left lung. Roentgenograms of the kidneys, ureters, bladder and stomach gave negative results. Roentgenological examination of the colon showed a polypoid defect at the hepatic flexure. After castor oil had been taken the mass in the left side of the abdomen had disappeared; then a mass had been palpated in the region of the ascending colon. This mass became palpable only with difficulty after further purging. A diagnosis of partial intestinal obstruction due to a polypoid lesion of the ascending colon was made.

December 17, 1928, exploration through a right rectus incision revealed a polyp about 6 centimeters in diameter in the ascending colon. Resection in two stages was decided on. Ileocolostomy was performed and January 5, 1929, this was followed by resection of the cecum and ascending colon.

The specimen obtained at operation (Fig 2) was an irregularly lobulated polypoid tumor 4.5 by 4 by 3 centimeters. The mass was attached to the mesial wall of the ascending colon approximately 10 centimeters above the ileocecal valve by a base which measured 2 by 1 centimeters. The mucosal covering of the tumor had a normal appearance except for the free end, where there was an area which extended more onto the superior and anterior surfaces. In this area the mucosa was absent and the color yellow. There was a linear healed scar 0.5 centimeter in length on the inferior surface. On the serosal surface, opposite the point of attachment of the tumor, there was a deep dimple filled with areolar connective tissue and large blood vessels. On section the tumor was found to be composed of yellow adipose tissue separated into lobules by bands of more dense opaque tissue. The area of attachment of the tumor to the muscular layer had a diameter of 0.5 centimeter, and the bulging into the dimple was surrounded by a groove. The angle between the mucosa and the surface of the tumor was filled with areolar tissue. The normal mucosa was separated from the yellow area on the free end of the tumor by a narrow necrotic zone. The muscularis mucosae could be traced almost to the zone of mucosal necrosis. The arrangement of the muscular layer was similar to that seen in Cases 1 and 2. The capsule which was indis-



Fig 8 Diffuse lipomatous infiltration of the submucosa of the superior labium of the ileocecal valve Case 27 (van Gieson's stain $\times 5$)

tinguishable from the submucosa and the septa contained numerous collections of leucocytes, mostly polymorphonuclear leucocytes, but also small and large mononuclear leucocytes which in places invaded the adipose structure.

Convalescence was uneventful. The patient was dismissed January 28, 1929.

The presence of the polypoid type of lesion was established by roentgenological examination. The changing site of the tumor suggested that it had a long pedicle or that intussusception was present. The long pedicle did not exist. In spite of the fact that no evidence that intussusception previously had existed was found at operation, intussusception seems to offer the only possible explanation of the events. The possibility that the polyp was benign was considered because of the existence, for years, of epigastric pain. The fact that adenomatous polyps are observed more frequently than are all other types made it probable that such a polyp was being dealt with here. An adenomatous polyp as large as the one found in this case usually is carcinomatous and demands wide removal of lymph nodes.

REPORT OF CASES IN GROUP 2

In this group of cases, the tumors did not produce symptoms. All of the reports, except in Case 14, are made on the basis of changes found at necropsy.

CASE 4. A male subject aged 64 years. A sessile mass 1 to 1.5 centimeters in diameter was found. It was composed of adult fat cells and was situated at the lesser curvature of the stomach, 6 centimeters from the pylorus in the submucosa and was covered by normal mucosa and muscularis mucosae.

CASE 5. A male subject, aged 67 years. A sessile mass, 9.5 by 4.5 centimeters, was situated at the greater curvature of the stomach. The mass extended onto the anterior and posterior walls of the stomach (Fig 3), and distally to within 1 or 2 centimeters of the pylorus projecting 5.5 centimeters into the lumen. It was composed of adult fat cells, was separated into lobules by connective tissue

septa, was enclosed in a fibrous capsule continuous with the submucosa, and separated hypertrophied muscular layers externally from the hypertrophied muscularis mucosae and normal mucosa internally. Occasional groups of four to eight small mononuclear cells were present in the supporting structures of the capillaries and occasionally in that of an arteriole.

CASE 6 A female subject, aged 65 years. A submucous lipoma, 8 millimeters in diameter, was found on the lesser curvature of the stomach.

CASE 7 A male subject, aged 74 years. A soft, yellow, submucous, sessile, pyriform gastric lipoma, the apex of which extended onto the pyloric ring, was found. It was attached by a base 3.5 centimeters long and 2 centimeters wide, which were the greatest diameters of the tumor. It was raised 1 centimeter above the mucosal surface and was covered by thinned but otherwise normal mucosa.

CASE 8 A female subject, aged 63 years. A soft, yellow, fatty, duodenal polyp, measuring 3 by 1 by 0.4 centimeters, flattened in the proximal and distal directions, was discovered. It was attached by a narrow pedicle composed of fibrous tissue and normal mucosa to a prominent plica circularis at a point 1 centimeter lateral to the ampulla of Vater. It was covered with thinned but otherwise normal mucosa.

CASE 9 A male subject, aged 81 years. A small, submucosal, finely granular, yellowish white duodenal lipoma was attached to the free edge of a plica circularis.

CASE 10 A female subject, aged 64 years. Two soft, yellow, duodenal lipomata, covered with normal mucosa, were found. They were situated 1 centimeter and 3 centimeters, respectively, below the ampulla of Vater on the posterior wall. The upper polyp measured 2 by 1.5 by 0.4 centimeter and was attached by a flattened pedicle, 1.5 centimeters broad, to the free edge of a plica circularis. The lower polyp measured 0.5 centimeter in diameter, and was similarly attached.

CASE 11 A male subject, aged 78 years. There was a duodenal lipoma, measuring 1.4 by 1.3 by 0.8 centimeter, attached by a short pedicle to a plica circularis just below the ampulla of Vater.

CASE 12 A male subject, aged 61 years. A lipoma, 8 by 3 by 4 millimeters, was found (Fig. 4). It was situated in the first part of the jejunum, and was attached by a short fibrous pedicle to a plica circularis. Occasional groups of several fat cells were present in the submucosal layers of the neighboring plica circularis.

CASE 13 A female subject, aged 61 years. There was a lipoma of the jejunum, 1 centimeter in diameter.

CASE 14 A woman, aged 37 years, underwent resection of the caecum, ascending colon, part of the transverse colon, and 6 centimeters of ileum for colitis. A submucous lipoma was found 5 centimeters proximal to the ileocecal valve.

CASE 15 A male subject, aged 21 years. Six submucous lipomata were scattered irregularly over 40 centimeters of the lower part of the ileum, of which the largest measured 1 by 1.5 centimeters. They were sessile, whether or not they were within a plica circularis. Associated findings were multiple subcutaneous lipomata, multiple lipomata of the dura, and abnormalities of the hands and nails.

CASE 16 A male subject, aged 53 years. There was a submucous, sessile lipoma of the ileum, 8 by 8 by 6 millimeters.

CASE 17 A male subject, aged 43 years. A soft, yellow lipoma, measuring 8 by 10 by 12 millimeters, was found. It was attached by a short pedicle in the lower part of the ileum, which was continuous with a poorly developed plica circularis. There was slight dimpling of the serosa

opposite the point of attachment of the pedicle. The mucosa was normal.

CASE 18 A female subject, aged 48 years. A small, sessile lipoma of the caecum, measuring 7 by 7 by 6 millimeters, was found.

CASE 19 A female subject, aged 63 years. A submucous lipoma of the caecum, measuring 10 by 10 by 4 millimeters, was found.

CASE 20 A male subject, aged 63 years. A submucous lipoma was situated on the lateral cecal wall, 2 centimeters above the level of the ileocecal valve. It measured 4.5 by 1.5 by 2 centimeters. Its long axis was transverse to the axis of the bowel, and it was attached by a base which measured 4 centimeters in one diameter and 1 centimeter in another diameter. The place of attachment was seen on the serosal surface as a yellowish area. The muscular coat, as previously described, was folded internally, separating the mucosa and the surface of the tumor for a short distance (Fig. 5).

CASE 21 A male subject, aged 35 years. A lipoma of the caecum, 1 centimeter in diameter, was present.

CASE 22 A male subject, aged 65 years. A yellow, lipomatous polyp, which measured 1.5 by 1 by 1 centimeter, was found. It was attached by a pedicle 1 centimeter in length to a plica semilunaris coli, 10 centimeters distal to the ileocecal valve.

CASE 23 A male subject, aged 65 years. A flattened, sessile lipoma, measuring 15 by 4 millimeters, was found in the ascending colon (Fig. 6). Small collections of fat cells on the submucosa gave a yellowish tint to the mucosa about the lipoma and distal to it for a distance of 5 to 6 centimeters.

CASE 24 A female subject, aged 62 years. The mucosal surface of the ascending colon was discolored by a faint yellow mottling. This was especially pronounced in the area surrounding a sessile lipoma, 1.5 by 1.5 by 0.5 centimeter, that was situated just distal to the ileocecal valve, on the medial wall of the ascending colon. The superior labium of the ileocecal valve was yellow, was 1.2 centimeters thick, and extended 1.5 centimeters into the lumen of the bowel. Microscopically, beneath the area of yellow tinted mucosa there was rich infiltration of the submucosa with fat cells. The thickening of the superior labium was due to adipose tissue situated almost entirely on the colic side of the infolding circular muscular fibers.

CASE 25 A female subject, aged 65 years. A sessile, submucous lipoma, measuring 1 by 1 by 0.4 centimeter, was situated 4 centimeters distal to the ileocecal valve. Submucosal infiltration gave a yellowish tint to the mucosa, as in Case 16. Thickening of the margin of the ileocecal valve gave the appearance of a ring with a small os, due to fat deposited both on the ileal and on the colic sides of the infolded circular fibers.

CASE 26 A female subject, aged 70 years. There was thickening of both margins of the ileocecal valve, so that the valve appeared as a slit. The mucosa was tinted because of deposits of fat, as in Case 25, but more marked. There were three sessile lipomata, one in the caecum, 1.5 by 2 by 0.4 centimeter, and two in the ascending colon, 1.5 by 1.3 by 3 centimeters, and 2.5 by 2 by 0.5 centimeter. Five other small lipomata, as well as numerous areas in which there was a more marked yellowish tint, with underlying small collections of fat, were found (Fig. 7).

CASE 27 A male subject, aged 57 years. Fatty thickening of the superior labium of the ileocecal valve (Fig. 8) and a submucous lipoma of the upper part of the sigmoid, 2 centimeters in diameter, were found.

CASE 28 A male subject, aged 81 years. A lipoma in the submucosa of the rectum, 1 centimeter in diameter, was present.

PREVIOUSLY PUBLISHED REPORTS

Stetten, in 1909, made a comprehensive review of the previously reported cases and presented 2 of his own. He tabulated the main points of interest in 77 cases in such a satisfactory way that it appears superfluous to do more than refer the interested reader to his paper for the abstracts of these cases. However, it could not be determined with certainty that the single cases each of Marchand, Zum Busch, and Ray, which Stetten included, were not of the subserous variety, and these are excluded from the total series of submucous lipomata. White and Judd, in 1929, found reports of 13 cases of submucous gastric lipoma and reported 1 case which had occurred recently at The Mayo Clinic. Three of 13 cases, reports noted in the literature by White and Judd, have been included by Stetten in his series. To their paper the interested reader is again referred for a résumé of those cases. Careful search has revealed reports of eight cases of gastro intestinal lipoma published prior to the date of Stetten's paper and not included by him and reports of 4 cases of gastric lipoma not included by White and Judd. In addition, 56 cases of intestinal lipoma have been reported since 1909. A total series of 153 reports of cases of gastro intestinal submucous lipoma previously published is made available for study by reference to the papers of the authors mentioned and to the following abstracts.

In the previous paragraphs, it has been noted that of the 77 cases reported by Stetten, 3 have been omitted from this review. Certain other cases included in other authors series have not been included. The cases of Levadna, of Power, and of Thorek have been excluded, because the tumors were not submucous lipomata. Those of Treves of Brohl, and of Kasey Meyer have been omitted because these authors merely quoted reports of cases given by other writers. More over, the specimens in the Birmingham Museum, in the Museum of the Royal College of Surgeons, and in the Leeds Museum, mentioned by Bland Sutton, and in the London Hospital Museum, mentioned by Treves, have not been included since it was not possible to ascertain that those specimens did not belong to cases already included.

CASE 29. Cruveilhier's case 1835-1842. The tumor was a sessile lipoma about 2.5 by 2 by 1 centimeters covered by intact mucous membrane. It was situated near the pylorus.

CASE 30. Brunner's case, 1807. The patient was a man aged 51 years. He experienced severe pain for 5 days and did not pass feces or flatus. There was abdominal distention and a bloody mucoid discharge. On

rectal examination a pedunculated tumor was found above the anus attached inside of the bowel that was invaginated into the rectum. At operation the tumor and part of the invaginated bowel were removed, and the opening was closed by suture. Colostomy was performed on the following day. Later, the opening made at colostomy was closed. The diagnosis was submucous lipoma. Cure was effected.

CASE 31. Garre's case 1898 (briefly described by Mattes 1909). The patient was a woman aged 75 years. Abdominal pain had lasted 8 days before diarrhea with out blood appeared and continued for 3 weeks. Anorexia and emaciation followed. A kidney shaped tumor was found near the umbilicus at the left end of which a small, half ball shaped tumor could be distinguished. Laparotomy disclosed chronic ileocolic intussusception, and a tumor at the left end of the intussusception. The intussusception was reduced and 12 centimeters of the intussusceptum was resected. A submucous lipoma about 2.5 centimeters in diameter was found 2 centimeters from the ileocecal valve. Cure was effected.

CASE 32. Haasler's case 1902. The patient was a man aged 25 years. He had had belching and heart burn for years. Three months before operation severe umbilical pain and diarrhea had occurred for 1 day. Since then colicky pain had been increased in severity by food. Rigidity and tenderness in the umbilical region were noted. The patient had vomited 2 days before admission. A tumor near the umbilicus which was tender on palpation moved to and fro with respiration. Pain and diarrhea with blood and mucus in the stool, persisted. At laparotomy intussusception of the transverse colon and numerous adhesions were found. Resection was performed with anastomosis by the Murphy button. At the apex of the intussusception was a submucous lipoma attached by a broad pedicle and covered by gangrenous mucosa. The patient recovered.

CASE 33. Lorenz's case 1906. The patient was a man aged 58 years. Abdominal pain symptoms of obstruction and loss of weight were complained of. A sausage shaped mass extending across the upper part of the abdomen which hardened under palpation and a tender tumor 5 centimeters in diameter at the left end of this mass were palpated. Laparotomy disclosed invagination of the ileum caecum and ascending colon. The intussusception was reduced. A pedunculated submucous lipoma about 5 centimeters in diameter covered by ulcerated mucous membrane and attached to the lateral cecal wall opposite the ileocecal valve was removed. Cure followed.

CASE 34. D'Este's case 1906. The patient was a man aged 54 years. Two months previously intense pain had occurred in the right lower quadrant of the abdomen lasting 3 hours. The pain had recurred at irregular intervals for 2 weeks. It was of short duration and was followed by alternating constipation and diarrhea. A tumor was palpated in the right side of the abdomen, it moved with respiration. It appeared smooth and ovoid its long axis running from above and to the right downward to the left. The size of the tumor between attacks was about 3 by 5 centimeters. It was larger during attacks, and tender. Active peristaltic movements progressed from the tumor to the left. The colon was incised at the hepatic flexure. A pear shaped submucous lipoma inserted by a broad base and covered by ulcerated mucosa and the involved segment were removed. The patient recovered.

CASE 35. Mattes case 1909. The patient was a man, aged 76 years. Constipation alternating with bloody diarrhea and pain in the lower part of the abdomen had been present for 3 weeks. For 4 days a pedunculated tumor about 4 by 6 centimeters appeared through the

anus repeatedly after replacement. Gas did not pass by rectum. The abdomen was distended. At laparotomy, intussusception of the sigmoid into the rectum and a palpable tumor in the sigmoid were found. The intussusception was reduced. A pedunculated, partly necrotic, submucous lipoma, covered by necrotic membrane and 14 centimeters of bowel were resected. The patient died.

CASE 36 Francini's case, 1909. The patient was a man, aged 55 years. A diagnosis was made of carcinoma of the stomach with lymphatic involvement. Gastroenterostomy and resection of two small submucous lipomata of the jejunum was carried out. The jejunal wall was hypertrophied. A similar nodule was not resected. The end results were not given.

CASE 37 Westbrook's case, 1910. The patient was a woman, aged 34 years. For 1 year she had had attacks of epigastric cramping pain, combined with symptoms supposed to originate in the stomach. The pain was lessened by gastric lavage. One month previous to operation, severe abdominal cramping radiating from the right to the median line, loose bowels in place of constipation, bloating, and flatulence had gradually developed. A mass, about 6 by 5 by 5 centimeters, was found to the right and on a level with the umbilicus. The mass shifted to the left of the median line when the patient was lying on the left side. Laparotomy disclosed a dilated, thickened, and inflamed ascending colon which enclosed an egg-shaped tumor 5 centimeters above the cecum. The mucosa of the colon was ulcerated. Resection of the cecum and ascending colon was carried out. Side to side anastomosis was performed, and a lipoma attached to the mesenteric border by a pedicle half the length of the tumor was removed. Recovery was effected.

CASE 38 Finney's case (reported by Wharton, 1911). The patient was a man, aged 35 years. Five weeks before operation he had had a sudden attack of abdominal pain, followed by a blood streaked stool. Frequent attacks of left sided pain occurred during the remainder of the day. An indefinite mass was palpable. The patient had had similar attacks 4 and 3 weeks before operation. For 3 weeks he had had pain in the back and rectum. Pain was elicited on pressure and muscular rigidity was found in the left part of the abdomen. Laparotomy disclosed a mass about 6 by 5 by 5 centimeters, just below the splenic flexure. A portion of the wall above the tumor was invaginated. The mucosa was gangrenous and ulcerated. A lipoma about 4 by 3 by 3 centimeters, which was somewhat pedunculated and attached to the mesenteric border, was resected. Recovery was effected.

CASE 39 Ehrlich's case, 1910. A woman, aged 62 years complained of constipation for a period of 6 months. Eight days before operation, severe pain of the lower portion of the abdomen developed. This was preceded by diarrhoea and a sense of incomplete evacuation, of several days' duration. The pain was more intense on the right side. The patient had been vomiting. Small liquid stools persisted, one stool contained blood. Gas was passed. Muscular rigidity and tenderness were more marked on the right side of the abdomen. There was a firm, tender mass, about 6 centimeters in diameter, in the right lower quadrant of the abdomen. Laparotomy disclosed a firm sausage-shaped submucous lipoma, about 5 by 2 centimeters, attached by a broad base 15 centimeters quad to the ileocecal valve. The serosa was dimpled opposite the attachment of the tumor. Ileocolostomy with resection of 30 centimeters of the ileum, was performed. The patient recovered.

CASE 40 Pettit and Malapert's case, 1912. The patient was a woman, aged 32 years. Duration of the symptoms was not given. A blood stained mucoid discharge per-

sisted, the patient complained of obstinate constipation with frequent desire to defecate, and tenesmus. There was protrusion of a tumor from the anus. Examination disclosed a bright red, firm, movable tumor, about 4 by 3 by 3 centimeters situated a few centimeters above the anus which was attached above to the mucosa of the intussuscepted bowel by a thick long pedicle. The lipoma was covered by ulcerated mucous membrane. The pedicle of the tumor was ligated and cauterized. Reduction of the intussusception was accomplished.

CASE 41 Fantino's case, 1912. The patient was a man, aged 37 years. Three days before operation severe abdominal pain followed by symptoms of occlusion developed. The abdomen was tympanitic. A few feeble intestinal contractions were noted. There was an enormously distended loop in the lower part of the abdomen. Torsion of the sigmoid, with displacement across the abdomen was diagnosed. At laparotomy, dilation of the upper part of the colon and intussusception of the transverse into the descending colon were found. Reduction of the intussusception was performed. The colon was incised and a pedunculated submucous lipoma which was attached to the wall of the transverse colon was removed. Colostomy was performed. The patient died.

CASE 42 Rinaldo's case, 1912. The patient was a man, aged 45 years. Twelve hours before examination, he experienced a sudden attack of abdominal pain, followed by a violent movement of the bowel, vomiting and hicough. The abdomen was distended, rigid and tender. A cylindrical firm, elastic tumor, 8 to 10 centimeters in diameter, extended vertically across the abdomen. Operation disclosed serosanguinous fluid in the abdomen. There was intussusception of 80 centimeters of the small bowel 215 centimeters of the bowel was resected, and a subserous and submucous lipoma about 4 by 3 by 3 centimeters at the apex of the area of intussuscepted bowel, was removed. Cure was effected.

CASE 43 Hengstenberg's case, 1913. A woman aged 21 years, complained of abdominal pain, with tenderness over the cecum. Appendectomy was performed for a perforating appendix. At operation appendices epiploicae up to about 10 centimeters in diameter, and numerous submucous lipomata from 2 to 4 centimeters in diameter, some of which were continuous with the subserous tumors and fatty tumors in the perirectal tissues, were found. Thirty seven centimeters of the descending colon and sigmoid were resected. The patient died.

CASE 44 Giorgi's case, 1912. A woman, aged 18 years, complained of recurring attacks of severe pain of the right lower quadrant of the abdomen radiating over the abdomen of a year's duration. The pain was accompanied by nausea, vomiting and diarrhoea. Enterorrhagia occurred during the first attack only. A palpable tumor was situated to the right of the umbilicus. It was cylindrical, about 8 centimeters in diameter and had a lobulated surface. The tumor was movable on respiration and by palpation. Diagnosis of chronic ileocecal intussusception was made. Laparotomy disclosed intussusception, reduction was impossible. Ileocolostomy was performed, with resection of a short section of the ascending colon, cecum and intussuscepted portion of the ileum. A submucous lobulated lipoma, about 5 by 3 by 3 centimeters, implanted into the ileal wall by a broad base and covered by normal mucosa, was removed. The termination in this case was not stated.

CASE 45 Goodall's case, 1912. The patient was a man aged 40 years. He complained of recurring attacks, of 1½ years' duration of intermittent cramping of the upper part of the abdomen. The cramping radiated to the left hypochondrium, and was relieved after 3 or 4

hours by movement of the bowel or by kneading of a tumor which appeared in either the right or left side of the upper part of the abdomen. This caused disappearance of the tumor and a rumbling gurgling sound. At laparotomy intussusception of 15 centimeters of ileum was found. Resection of a pedunculated lipoma nearly filling the cavity of intussusception, was performed. Recovery was effected.

CASE 46. Randis's case 1912. The patient was a man, aged 65 years. Daily, for 28 months he had vomited 15 minutes after eating. He complained of vague epigastric pain, emaciation and lately mental confusion. Resection of a portion of the stomach including a triangular pyramatic yellow submucous lipoma 2 centimeters above and partially obstructing the pylorus, was performed. Cure was effected.

CASE 47. Collins's case 1913. The patient was a woman aged 50 years. For 2 or 3 days 2 weeks previous to examination she had had attacks of pain in the right lower quadrant of the abdomen several times daily, accompanied by nausea and vomiting. Following this attack, there had been a blood stained mucoid discharge four or five times a day. Examination revealed a fixed, oblong mass lying obliquely in the left lower part of the abdomen. Laparotomy disclosed intussusception. Reduction of the intussusception was accomplished. A solid round pedunculated lipoma 5 centimeters in diameter attached to the inner wall of the cecum was removed. Recovery was effected.

CASE 48. André's case 1913, (also Hohmeier's case 1913). The patient was a woman, aged 66 years. She had had recurring attacks of cramping of the lower part of the abdomen, vomiting and constipation, of 5 weeks duration. The abdominal wall was tense and painful on pressure. Peristalsis and a tumor in the right portion of the abdomen were present. Laparotomy disclosed intussusception of 20 centimeters of ileum into the colon. Resection was performed with side to side anastomosis. A submucous lipoma, about 1.5 centimeters in diameter, attached to the apex of the region of intussusception was removed. There was some inflammatory reaction in the tumor. Recovery was effected.

CASE 49. Cicala's case 1913. The patient was a woman aged 59 years. She had had an intense burning sensation in the hypochondrium after meals later, paroxysmal pain and a swelling near the umbilicus which increased in size after ingestion of food had developed. A soft elastic cylindrical movable tumor, tender only on firm palpation was found. Laparotomy disclosed intussusception of the cecum into the transverse colon. The intussusception was reduced. A soft elastic, yellow, submucous lipoma of the cecum about 8 centimeters in diameter was removed by two lozenge shaped incisions. Recovery was effected.

CASE 50. Tromps's case 1915. The patient was a woman aged 32 years. She had had recurring attacks of gall stone colic for 4 years during this time she had had five attacks of generalized abdominal pain with symptoms of obstruction. Examination revealed an oblong smooth tender mass about 10 centimeters in diameter attached to an enlarged liver and a smaller tumor in the right lower quadrant of the abdomen, which had disappeared by the following day. Laparotomy disclosed hydrups of the gall bladder. Cholecystectomy was performed. Twenty days after operation there was recurrence of the obstructive symptoms and a tumor in the right lower quadrant of the abdomen. Laparotomy revealed intussusception of the ileum into the cecum. The apex was in the transverse colon. Reduction was effected until the apex was in the ascending colon. Resection and ileo-

colostomy were performed. A submucous lipoma covered by ulcerated mucous membrane 4 centimeters in diameter situated 20 centimeters above the ileocecal valve and attached by a pedicle 8 centimeters long and 3 centimeters thick, was removed. Recovery was effected.

CASE 51. Harrigan's case 1916. The patient was a man aged 50 years. For 2 months he had had sharp cramp like pains in the epigastrium radiating to the right lower quadrant of the abdomen, occurring two or three times a day at the onset, and increasing until they occurred every 30 minutes and were accompanied by vomiting when the patient was admitted to the hospital. Examination disclosed distention and a tender mass in the right lower quadrant of the abdomen. Leucocytes numbered 14,600 in each cubic millimeter of blood 85 per cent of which were polymorphonuclear leucocytes. The temperature was 100 degrees F. At laparotomy ileocecal intussusception was reduced. The bowel was incised 75 centimeters from the ileocecal valve and a soft submucous pedunculated lipoma 6.5 by 6.5 centimeters which was attached at the mesenteric border was removed. Recovery was effected.

CASE 52. Kellert's case 1917. The patient was a man aged 46 years. He gave a 6 months history of abdominal cramping which was most marked in the epigastric region constipation and loss of weight of 20 pounds. A tumor was palpable in the right side of the abdomen. At laparotomy, the cecum ascending colon and a portion of the ileum were resected. Ileocolostomy was performed. A spheroidal sessile lipoma of the cecum 3 centimeters in diameter and covered by necrotic mucosa was removed.

CASE 53. Lewisohn's case, 1918. The patient was a woman aged 50 years. For 2 months she had had short attacks of severe intermittent right abdominal pain with abdominal distention between attacks. There was no blood in the stools. A round movable nodular mass at the level and to the right of the umbilicus was palpated. Roentgen ray examination disclosed a tumor protruding into the ascending colon. At laparotomy, resection and lateral anastomosis were performed. A pendulous lipoma about 3 centimeters in diameter, on the inner wall of the ascending colon was removed. The base of the tumor was soft the distal portion was hard nodular and gangrenous. Recovery was effected.

CASE 54. Nigst's case 1918. The patient was a man aged 55 years. About 1 month before operation there was onset of pain which at first was mild inconstant and situated at the left of the umbilicus and accompanied by constipation later the pain increased the stools became small and diarrhea developed. A tumor about 6 centimeters in diameter, somewhat spindle shaped, movable smooth and of firm elastic consistence was palpated. At laparotomy a portion of the descending colon just below the splenic flexure was resected and an end-to-end anastomosis was performed. A submucous lipoma covered by normal mucous membrane and attached by a short thin pedicle to the lateral wall of the bowel was removed. There was dimpling of the serosa opposite the point of attachment of the pedicle. Recovery was effected.

CASE 55. Landauer's case, 1919. The patient was a man aged 59 years. Seventeen months previous to examination, he had had anorexia constipation, vomiting and a sensation of pressure for 2 months. These symptoms had recurred 9 months later. He had been unable to work thereafter. An indefinite tumor, about 3 centimeters in diameter above the umbilicus was palpated. Laparotomy disclosed intussusception with a mushroom shaped lipoma, 5 by 3 centimeters attached by a broad pedicle in the ascending colon and enucleated extramucosally. Recovery was effected.

CASE 56 Brouwer's case, 1921 The patient was a man, aged 45 years He gave a history of chronic intermittent ileus for a period of 4 years Examination disclosed a cylindrical tumor in the ileocecal region the site, size, and consistence of which varied considerably At laparotomy, the ileocecal valve and 10 centimeters of ileum was resected A pedunculated lipoma, about 2 centimeters in diameter, attached to the ileocecal valve, was removed Results were not given

CASE 57 Schneller's case, 1920 The subject was a man, aged 55 years, whose death was the result of pulmonary tuberculosis Ninety submucous lipomata, varying from a very small size to 1.5 centimeters in diameter some of which were pedunculated and some sessile, and covered by normal mucous membrane, were distributed through 120 centimeters of bowel, starting at a point 20 centimeters below the duodenum

CASE 58 Compton's case, 1920 The patient was a woman, aged 30 years Constipation had persisted for many years Examination revealed a lipoma in the fold of the ileocecal valve, passage from the ileum to the cæcum was through a ring of fat covered by attenuated mucous membrane Excision of the cæcum was performed Cure was effected

CASE 59 Greenwood's case (reported by Bland Sutton, 1920) The patient was a woman, aged 31 years Operation revealed a lipoma 4 centimeters in diameter, covered with ulcerated mucous membrane and attached by a short pedicle in the ascending colon The cæcum and adjacent colon were resected

CASE 60 Balmagne's case, 1920 The patient was a woman, aged 68 years She had had life long constipation For 2 years she had had abdominal pain and increased constipation and had lost 23 pounds in weight She complained of pain and vomiting At laparotomy, intussusception of the small bowel was reduced The wall of the bowel was incised over a pedunculated lipoma, about 5 centimeters in diameter, and the tumor was removed The involved portion of the bowel was resected and an end to-end anastomosis was performed Cure was effected

CASE 61 Labe's case, 1920 The patient was a woman, aged 46 years She had had three attacks of abdominal pain, with mucoid evacuations, in the last 4 years At the time of examination, an attack was of 12 days' duration Colicky pain with obstinate constipation and melæna persisted Roentgenograms disclosed obstruction in the middle part of the transverse colon At laparotomy, a movable tumor, about 6 centimeters in diameter, in the superior part of the ascending colon, was found, the transverse colon was distended Caecostomy was performed Twenty seven days after operation, incision of the intestine was done A submucous lipoma, about 4 by 3 by 3 centimeters, attached by a broad base and covered by ulcerated mucous membrane was excised Recovery was effected

CASE 62 Longo's case, 1920 The patient was a woman, aged 47 years Forty seven days previous to examination, right abdominal, colicky and intermittent pain, developing slowly after meals had been present Later, vomiting and marked constipation developed There was a mass in the ileocecal region Cholecystectomy for cholecystitis was performed The cæcum was incised, and a submucous lipoma, about 5 centimeters in diameter, and covered by hyperæmic, thin, eroded mucosa, was removed Cure was effected

CASE 63 Kothney's case, 1919 The patient was aged 43 years For 3 months the patient had had a cramp-like abdominal pain appearing 1 to 1½ hours after meals, and reaching its greatest severity 2 to 2½ hours after meals The pain was less intense if the bowels were loose There

was loss of weight A tumor, about 10 centimeters in diameter, was found in the left lower quadrant of the abdomen After taking a purgative the patient passed a lipoma 14 by 8 by 9 centimeters, covered with blood and mucus An area, 10 by 5 centimeters denuded of mucosa, which elsewhere was characteristic of the mucosa of the large bowel, was observed Cure was effected

CASE 64 Odelberg's case, 1921 The patient was a man aged 48 years Fifteen days before operation, chilliness, malaise, and diarrhoea had developed The day before operation, pain in the right portion of the abdomen, vomiting, constipation, distention, and generalized abdominal tenderness had developed There was muscle spasm of the right flank An enema returned blood stained At laparotomy intussusception was found The ileum, cæcum and ascending colon were resected and an end to-end anastomosis was performed A submucous, pedunculated lipoma, 4 by 2.5 by 2 centimeters, was attached 30 centimeters above the valve Recovery was effected

CASE 65 Odelberg's case, 1921 The patient was a woman, aged 61 years For the last 7 years, she had had violent attacks of right abdominal pain, accompanied by vomiting and diarrhoea At laparotomy an ileal intussusception, about 30 centimeters, was reduced Resection was performed, and an end to-end anastomosis was done A yellow, elastic submucous lipoma, 7.5 by 3.5 centimeters, protruded 1.5 centimeters externally The serosa was thickened over the tumor (submucous and subserous) Recovery was effected

CASE 66 Odelberg's case 1921 (museum specimen) The tumors were three submucous, pedunculated lipomata of the jejunum, about 1.5 centimeters in diameter

CASE 67 Odelberg's case, 1921 (museum specimen) The tumor was a submucous jejunal fibrolipoma, about 2 by 1 by 0.5 centimeter, with a pedicle 4 centimeters long

CASE 68 Odelberg's case (necropsy record), 1921 A lipoma about 2.5 by 2 by 1 centimeter, was attached to a diffusely fibrous and thickened mesosigmoid by a twisted pedicle Four pedunculated lipomata varying in size from 2 by 1 by 0.5 centimeter to 2.5 by 2 by 1 centimeter, were attached to the omentum There was also a pedunculated lipoma, about 1.5 centimeters in diameter, of the mesentery of the lower portion of the ileum, and a subperitoneal lipoma in the middle portion of the small intestine bulging as much inside the lumen as outside It was stated that the latter tumor was definitely submucous

CASE 69 Dunet's case, 1921 A small submucous lipoma of the fourth part of the duodenum was encountered at necropsy in a case in which the patient had died of pulmonary tuberculosis Symptoms of tumor had not been present

CASE 70 Rinaldo's case, 1912 The patient was a man, aged 51 years He had had recurrent attacks of constipation for years During the last month at each evacuation, protrusion of a bleeding, hard growth through the anus had occurred It was replaceable by the fingers Following physical effort, protrusion again occurred, and the growth could not be replaced Later, the intestine came through the anus causing intense pain and vomiting A spheroidal, pedunculated tumor in the cylinder of the prolapsed and intussuscepted intestine was found at operation, extirpation of a submucous lipoma was performed Laparotomy disclosed necrosis of the sigmoid Resection and end to-end anastomosis were done Cure was effected

CASE 71 Forster's case, 1921 The patient was a woman aged 59 years For the last 10 years, she had had increasingly frequent lower abdominal cramps For

23 weeks there had been vomiting visible peristalsis and an intermittently appearing tumor about 8 centimeters in diameter below the umbilicus. Laparotomy disclosed a tumor about 10 centimeters in diameter in the transverse colon. Ileocolostomy was performed. Twenty-seven days later resection of 30 centimeters of colon was done and a submucous lipoma covered by normal mucosa was removed. Recovery was effected.

CASE 72. Forster's case 1921. The patient was a man aged 48 years. He had always suffered from abdominal pain and distention. There had been a sudden onset of generalized severe abdominal pain accompanied by distention and vomiting. Flatus was not passed. A diagnosis of invagination or obstruction by a band of adhesions and ileus was made. Laparotomy disclosed invagination of the ileum into the ascending colon. Disinvagination was done and a smooth lipoma 3 by 2 by 1 centimeter 30 centimeters proximal to the ileocecal valve at a point of mesentery attachment was excised. The muscular layer was absent. A tumor protruded into and external to the lumen of the bowel. It was both submucous and subserous and there was infiltration with leucocytes and erythrocytes. Cure was effected.

CASE 73. Deroque and Deroque's case 1924. The patient was a woman aged 30 years. For 6 years there had been intermittent abdominal pain worse on the left side and severe enough for the patient to remain in bed. Forty-two days before examination she had had severe attacks of ileal pain usually in the right side but sometimes in the left side. Morphine was necessary. Laparotomy disclosed appendicitis and a vascular cæcum. Appendectomy was performed. A lipoma about 5 centimeters in diameter covered by normal mucous membrane and attached posteriorly near the appendiceal orifice by a base about 3 centimeters in diameter was found in the cæcum and was removed by sectioning the base of the implantation. Cure was effected.

CASE 74. Carlucci's case 1921. The patient was a woman aged 43 years. She had had progressively more severe attacks of abdominal pain during the last 3 months, which occurred every 4 to 7 days. The pain was more severe in the right lower quadrant of the abdomen. Lasted 20 hours and was relieved by movement of the bowel. Nausea and at the last fecal vomiting occurred. Blood was found in the stool. There was moderate abdominal distention. Ileus was present. At operation intussusception of the transverse colon into the sigmoid was found. Free fluid was present. Resection and side to side anastomosis were performed and a pedunculated encapsulated lobulated lipoma 9 by 8 centimeters attached to the apex of the region of intussusception was removed. Death resulted.

CASE 75. Carlucci's case 1921. The patient was a man aged 53 years. During the last month he had had four or five attacks of umbilical pain daily, which lasted 4 to 5 seconds. Examination disclosed an oblong mass in the left portion of the abdomen. Blood was present in the stools. At operation the cæcum and ileum were resected and end to side anastomosis was performed. An encapsulated nodular submucous lipoma covered with mucous membrane attached by a fibrous pedicle 3 centimeters long to the mesenteric border of the ileum and extending through the ileocecal valve into the cæcum was removed. Cure was effected.

CASE 76. Chabier and Dunet's case (13-14) 1921. The patient was a man aged 46 years. Five days previous to examination severe pain had occurred in the left lower quadrant of the abdomen and symptoms of acute obstruction were present. A diagnosis of volvulus of the sigmoid was made. Operation disclosed a distended and hyper-

trophied sigmoid the result of adhesions. There was an intussusception in the descending colon just below the splenic flexure. The colon was incised, and a pedicle of a submucous lipoma about 5 by 3 by 3 centimeters was amputated. There was necrosis of the mucosa at the free end of the tumor. The termination was not stated.

CASE 77. Vaccari's case 1923. The patient was a man aged 65 years. Four days before examination intermittent severe pain of the right lower portion of the abdomen had occurred. The pain radiated over the entire abdomen especially to the umbilicus and was accompanied by nausea, vomiting, and later hiccough. Two liquid stools were passed soon after onset of the pain but no further passage of feces or gas occurred. There was slight distention, moderate rigidity, and tenderness. At laparotomy, ileal intussusception was found. Ileocolostomy and resection of a pedunculated submucous lipoma about 2 centimeters in diameter covered by necrotic mucous membrane and attached near the apex of the intussusception was performed. On the external surface was found a small bilobate subserous lipoma at the point of attachment of the peduncle of the submucous lipoma and near the insertion of the mesentery. The muscle layers were intact separating the points of origin of the pedicles. General peritonitis and death followed.

CASE 78. Degener's case 1925. The patient was a man. For 8 years at long intervals blood had been present in the stools. At operation a submucous lipoma 4 by 3 by 1 centimeter was found in the duodenum. A scar at the apex of the tumor was assumed to be the site of healed ulceration and the source of bleeding.

CASE 79. Verger and Massis's case 1922. The subject was a woman aged 58 years. During the last month she had had anorexia, nausea, and diarrhoea. Free hydrochloric acid was absent. There was irregularity of the contour of the upper part of the pylorus. Necropsy revealed cirrhosis of the liver and probably early carcinoma at the pylorus also a submucous sessile lipoma about 1.5 centimeters in diameter on the greater curvature of the stomach 5 centimeters above the pylorus.

CASE 80. Nash's case 1924. The patient was a woman aged 61 years. Six months previous to examination she had had an attack of diarrhoea followed by attacks of abdominal pain and severe constipation. One week previously severe colicky pain and vomiting had occurred. Tenderness and rigidity were present in the right lower quadrant of the abdomen. At operation, the appendix was found to be thickened but not inflamed. The cæcum felt like a mass of worms. When it was incised a submucous lipoma measuring 10 by 6.25 centimeters projecting from the posterior wall was shelled out. Cure was effected.

CASE 81. Kaufmann's case 1922. The subject was a woman aged 72 years. Necropsy revealed a pedunculated lipoma of the transverse colon.

CASE 82. Kaufmann's case 1922. The subject was a woman aged 62 years. Necropsy revealed a pedunculated lipoma of the ascending colon.

CASE 83. Dittrich's case 1924. A specimen was presented of a submucous lipoma of the ascending colon causing intussusception and chronic ileus. Resection of the ascending and transverse colon had been performed in Kuttner's clinic. Recovery was effected.

CASE 84. Vogeler's case 1924. The patient was a woman aged 67 years. She had had constipation for many years. Recently it had become severe and was accompanied by a sense of obstruction and severe pain with movements of the bowel. Two days before admission severe pain and vomiting had occurred. Proctoscopic examination revealed an obstruction and a movable,

bluish red, tender tumor, about 10 centimeters in diameter, which bled easily and was situated above the anus. A diagnosis was made of torsion of the pedicle of the tumor. Four days later the tumor was passed spontaneously. It was a grayish, infarcted, necrotic, bazaric rhagic fibrolipoma.

CASE 85. Patsch's case, 1924. The patient was a man, aged 59 years. Three months previously, there had been an extrusion of a round lump from the anus by forceful action of the bowel. Spontaneous replacement had occurred. Ten days previously, there had been reappearance of the tumor. It was irreducible. Stools were thin and their passage was painful. Examination disclosed a dark brown, firm, nodular, encrusted, and dry tumor, about 10 centimeters in diameter, which smelled foul and was attached by a pedicle 8 centimeters above the anus on the right lateral wall. The tumor was drawn out the pedicle was ligated and cut by cautery. Cure was effected.

CASE 86. Stremmler's case, 1924. The subject was a man, aged 40 years. A submucous pedunculated lipoma of the duodenum, attached near the papilla of Vater, was found. There was a second lipoma, attached to the free border of a fold of the mucosa, situated 0.75 centimeter from the first lipoma.

CASE 87. Swanson's case, 1924. The patient was a man, aged 59 years. He had had epigastric pain of 9 months duration. The pain shifted to the right or left hypochondrium. At first it was dull, later it was acute and stabbing. A movable tumor was noted 2 months previously. There was relief of pain with disappearance of the tumor. Laparotomy disclosed 10 centimeters of ileum invaginated through the ileocecal valve, there was invagination of the valve, ileum and cecum into the ascending colon. Reduction of the invagination was accomplished, and a submucous fibrolipoma, 3.7 by 4.2 centimeters, attached by a 2 centimeter circular base on the antimesenteric border, was resected, and end to end anastomosis was performed. Recovery was effected.

CASE 88. Belz's case, 1925. The sex and age of the patient were not given. A presumptive diagnosis was made of partial ileus from adhesions. At laparotomy, the cecum and ascending colon were resected, and a submucous lipoma, about 8 centimeters in diameter, of the ascending colon, was removed. An uneventful convalescence followed.

CASE 89. Tanasescu and Barhulan's case, 1926. The patient was a man, aged 54 years. He had had constipation alternating with diarrhoea, flatulence and distress after meals over a long period of years. There had been recurring attacks of umbilical pain and passage of gas, but no faeces. Examination disclosed visible peristalsis and a rounded, firm, elongated mass appearing and disappearing. Roentgen ray examination, 6 hours after a barium meal, revealed the colon filled to the sigmoid, the proximal portion of the transverse colon was narrowed and had an irregularly dentated border. At operation intussusception of the transverse colon was found. Disinvagination resection of a movable tumor, and end to end anastomosis were performed. A submucous lipoma, about 10 centimeters in diameter, soft and lobulated attached at the mesocolic border by a base 4 by 6 centimeters and covered with normal mucosa except for a small, ulcerated area, was removed. Cure was effected.

CASE 90. Viannay's case, 1926. The patient was a woman, aged 38 years. She had had rectal bleeding for 4 months, with recurrent expulsion from the anus of a round tumor, about 4 centimeters in diameter. For 2 months tenesmus and a frequent desire to defecate had been present. At laparotomy, intussusception of the sigmoid into the rectum was reduced. The sigmoid was

incised and submucous enucleation of a solid, non pedunculated submucous lipoma was performed. Cure was effected.

CASE 91. Heinenon's case, 1926. The patient was a woman, aged 35 years. She had had pain and diarrhoea for 6 weeks. Later, vomiting and abdominal distention and tenderness had developed. At laparotomy, disinvagination of 8 centimeters of intussusception was performed. A round, firm, submucous lipoma, 3 by 3 by 2.5 centimeters, attached at the mesenteric border by a pedicle 2.5 centimeters long, was excised.

CASE 92. Latouche's case, 1926. The patient was a man, aged 38 years. He had had recurring attacks of diarrhoea and vomiting. Three days previous to admission, he had had generalized paroxysmal abdominal pain and vomiting which required morphine. There had been no flatus or movement of the bowel. A diagnosis was made of a ruptured appendix. Laparotomy disclosed free fluid in the peritoneal cavity. The appendix was normal. The cecum was grayish green. Non reducible ileocecal intussusception was found. Lateral entero anastomosis and resection was performed. A pedunculated, rounded, necrotic tumor, about 4 by 3 by 3 centimeters, at the apex of the intussusception, was found. It was composed largely of fat containing areas of connective tissue polymorphonuclear leucocytes, and hamorrhage, and was probably a fibrolipoma. Death resulted from embolism.

CASE 93. Weicker's case, 1928. The patient was a man, aged 60 years. He had had pain on pressure in the left side of the epigastrium, which was worse when the stomach was empty. There had been occasional vomiting and diarrhoea. A test meal showed absence of blood and free hydrochloric acid. Roentgen ray examination disclosed a tumor of the greater curvature. At operation, the stomach was incised and a spherical, sessile, submucous lipoma, about 8 centimeters in diameter, on the middle third of the posterior wall near the greater curvature, was extirpated. Cure was effected.

CASE 94. Douglas's case, 1926. The patient was a woman, aged 41 years. She had had pain in the lower portion of the abdomen, constipation, and intermittent abdominal distention. There was a mass in the left inguinal region. A filling defect in the sigmoid was present. Fifteen centimeters of the sigmoid was resected, and end to end anastomosis was performed. The tumor was a submucous lipoma, the mucosa was ulcerated. Cure was effected.

CASE 95. Polak's case, 1928. The patient was a woman, aged 43 years. She had had severe abdominal pain 3 weeks previous to admission. Intermittent pain and vomiting had persisted. Ten to 12 centimeters of the ileum was invaginated 50 to 60 centimeters above the ileocecal valve. Disinvagination was accomplished, and a submucous lipoma, about 2 centimeters in diameter, attached by a thick pedicle to the antimesenteric border, was extirpated. Recovery was effected.

CASE 96. Polak's case, 1928. The patient was a woman, aged 47 years. She complained of colicky pain of the right portion of the abdomen. A movable tumor was present. The cecum and ascending colon were resected and ileocolostomy was performed. A pedunculated lipoma, about 8 centimeters in diameter, covered by necrotic mucous membrane, and attached to the hypertrophied wall of the ascending colon, was removed. Recovery was effected.

GENERAL COMMENT ON THE ONE HUNDRED AND EIGHTY-ONE CASES KNOWN TO HAVE OCCURRED

Doubtless the reader has noted that the last abstract of a report of a case is numbered 96

TABLE I—SITUATION OF GASTRO-INTESTINAL LIPOMATA WITH RESPECT TO PRODUCTION OF SYMPTOMS

| Situation | With Symptoms | Without Symptoms | Total |
|--------------------------------------------------------|------------------|---------------------|-------|
| Stomach | 5 | 17 | 22 |
| Duodenum (definitely) | 1 | 12 | 13 |
| Duodenum (probably) | 2 | | 2 |
| Jejunum (definitely) | 2 | 9 | 11 |
| Ileum (definitely) | 25 | 9 | 34 |
| Small intestine (not further localized) | 4 | 1 | 5 |
| Total small intestine | 34 | 31 | 65 |
| Ileocaecal valve only | 2 | | 2 |
| Ileocaecal valve caecum and ascending colon (multiple) | | 1 | 1 |
| Ileocaecal valve and ascending colon (multiple) | | 2 | 2 |
| Ileocaecal valve and sigmoid (multiple) | | 1 | 1 |
| Caecum only | 12 | 4 | 16 |
| Caecum and ascending colon (multiple) | 1 | | 1 |
| Ascending colon only | 11 | 3 | 14 |
| Hepatic flexure only | 2 | | 2 |
| Transverse colon only | 9 | 1 | 10 |
| Descending colon only | 7 | | 7 |
| Descending colon and sigmoid (multiple) | | 1 | 1 |
| Sigmoid only | 11 | 1 | 12 |
| Probably sigmoid only | 2 | | 2 |
| Colon only | 4 | 2 | 6 |
| Probably colon only | 5 | | 5 |
| Throughout entire colon (multiple) | | 1 | 1 |
| Rectum only | 8 | 1 | 9 |
| Total large intestine | 74 | 18 | 92 |
| Apparently intestinal (data insufficient) | 1 | 1 | 2 |
| Grand total | 114 | 67 | 181 |

The 85 cases which represent the difference between 96 and 181 are accounted for in the articles by Stetten and by White and Judd, to which reference has been made.

Incidence. Benign neoplasms of the gastro-intestinal tract are comparatively rare. Eusterman and Senty found records indicating that 1.3 per cent of new growths of the stomach for which operation was done at The Mayo Clinic between the years 1907 and 1921 were benign. A similar small percentage in all probability would obtain for benign new growths of the entire gastro-intestinal tract, and of these, submucous lipomata form a small subdivision. Thus, Staemmler reported the occurrence of 116 adenomatous polyps and only 9 lipomata and 9 myomata of the small and large intestine, among 17,000 postmortem examinations. Staemmler also reported finding reports of cases of 88 myomata, 103 lipomata, and 26 fibromata and myxomata. The number of reported cases of lymphangioma and haemangioma is much smaller. Helvestine, in 1923, found reports of

14 haemangioma of the small and large bowel. It appears that lipomata occur in approximately the same frequency as myomata, that they are next to the adenomatous polyps in frequency, and that they are considerably more common than fibromata, myxomata, haemangioma, and lymphangioma of the small and large bowel.

Lipomata of the stomach appear to be equally as uncommon as those of the small and large bowel. Balfour and Henderson, in their series of 58 benign neoplasms of the stomach, did not find a lipoma.

The incidence of lipomata found at necropsy varies. In the series seen at The Mayo Clinic, 24 submucous gastro-intestinal lipomata were found in 3,924 consecutive necropsies, an incidence of 0.6 per cent. Twenty of these were situated in the small or large intestine, an incidence of 0.5 per cent, which is somewhat larger than the incidence of 0.05 per cent which Staemmler found in 17,000 cases. Again, Eliason and Wright found only one lipoma of the stomach in 8,000 necropsies, whereas the records of the clinic show 4 in 3,924 necropsies, a frequency approximately eight times greater than that of Eliason and Wright. With more careful examination than is usually accorded the small and large bowel, the reported incidence will increase.

It has been stated that lipomata of the stomach are less common than those of the small and large bowel. That only 5 of the 114 lipomata which produced symptoms, or 22 of the total of 181, were situated in the stomach bears this out. On the contrary, it does not follow that the tendency to formation of lipomata is less in the stomach than in the intestines. If there existed some means of comparing the unit areas of mucosal surface in the stomach with that in the intestines, it probably would be found that lipomata for a unit area of mucosa in the stomach are as numerous as lipomata for a unit area in the intestines.

A study of Table I reveals some additional interesting facts in regard to the incidence of lipomata in the various parts of the gastro-intestinal tract. Lipomata are about half again as common in the large as in the small intestine, lipomata which produce symptoms are about twice as common in the large as in the small intestine. Apparently lipomas are more common in the small bowel in those cases in which they are discovered incidentally at necropsy or at operation. However, in the series in which they were discovered at necropsy in the clinic, they were equally divided between small and large bowel. Lipomata in the small intestine are most

common in the ileum, and least common in the jejunum, in the large intestine, they are most common in the cæcum and ascending colon and next most common in the sigmoid. Sixteen of the 35 ileal lipomata were situated within 75 centimeters of the ileocæcal valve, and very few of the remaining lipomata definitely were in the upper part of the ileum. It seems that lipomata tend to occur more commonly in those segments of the gastro-intestinal tract composed of the stomach and duodenum, and of the lower part of the ileum, cæcum, and ascending colon. In the stomach, moreover, the majority are situated in the distal half. If this grouping in the segments of the gastro-intestinal tract bordering its distinct anatomical divisions, the pylorus and the ileocæcal valve, has any significance, it is not apparent. However, it invites speculation as to whether some physiological characteristic of these portions of the gastro-intestinal tract favors formation of lipoma.

This distribution varies from that found by Virchow, who stated that lipomata are more common in the stomach and upper parts of the small intestine. It differs also from that described by Nothnagel, who claimed that their favorite site was the rectum or lower part of the ileum, or that by Stetten, who found them about equally divided between small and large bowel.

The cases were about equally divided between the sexes, there were 81 in males and 72 in females among the 155 cases in which sex was mentioned.

Table II gives the ages at which the lipoma was found at operation or at necropsy. Seventy-two per cent of the 101 lipomata which produced symptoms and 76 per cent of the 149 lipomata, composed both of those which produced symptoms and those which did not produce symptoms, in cases in which the age of the patient was known, occurred after the age of 39 years, or within the so-called cancer age.

Pathological anatomy Fat cells frequently were found in the submucosa of the gastro-intestinal tract (Fig. 7). In the material obtained at necropsy, which was available for study, the fat cells were discrete, occasionally were in groups, or were diffusely distributed. They were sometimes sufficient in number to give a yellowish tint to the mucosa, with or without the formation of small lipomata 3 to 4 millimeters in diameter or larger (Group 2, Cases 23, 24, 25, and 26). The fatty infiltration may be found in one region or in multiple regions, or it may be distributed diffusely. Whether lipomata are believed to be metaplastic, heterotopic, inflam-

TABLE II—AGE OF INCIDENCE OF GASTRO-INTESTINAL LIPOMATA WITH RESPECT TO PRODUCTION OF SYMPTOMS

| Age | Years | Causing Symptoms | Not Causing Symptoms | Total |
|------------|-------|---------------------|-------------------------|-------|
| Under 20 | | 2 | 1 | 3 |
| 20 to 29 | | 5 | 3 | 8 |
| 30 to 39 | | 21 | 2 | 23 |
| 40 to 49 | | 29 | 4 | 33 |
| 50 to 59 | | 27 | 9 | 36 |
| 60 to 69 | | 14 | 19 | 33 |
| 70 to 79 | | 2 | 7 | 9 |
| 80 to 89 | | 1 | 3 | 4 |
| Not stated | | 13 | 19 | 32 |
| Total | | 114 | 67 | 181 |

matory, or neurosecretory in origin, the growth of these collections of fat cells into single lipomata, multiple lipomata (observed thirteen times), or diffuse lipomata (probably Knowlton's case represents this type), is easily visualized. In different instances, the process is demonstrable in all stages, from that of a small collection of cells in the submucosa (Fig. 7) to that of a large tumor.

The fat cells observed were of the adult type. No immature cells, such as those described by Staemmler, on the periphery of the small lipoma, were observed. The microscopic tumors were enclosed in the connective tissue of the submucosa. As the tumors increased in size, the line of demarcation between the submucosal connective tissue and the fat became more definite, and the development of the submucosal connective tissue into a thin or a comparatively thick capsule was accomplished. Even in the small tumors, septa dividing the tumor into lobules were seen. Such septa might be very fine or comparatively heavy. As the proportion of connective tissue increases, one is more inclined to apply the term fibrolipoma to the growths.

Arterioles and numerous capillaries, each with an amount of supporting stroma in proportion to the size of the vessel, were present. In the supporting stroma of the blood vessels, in the small, symptomless tumors, could be found occasional groups of three to five small, mononucleated cells, groups of cells which have been pointed to as evidence of the inflammatory origin of these tumors.

The mucosa was thinned and atrophic, or normal, in appearance. The muscularis mucosæ in the smaller tumors could be traced intact over the surface. In the larger tumors it became faint or unrecognizable.

The muscular layer in the smaller tumors was not obviously affected. In the larger sessile tumors, this layer was thinned, and the yellow

of the fat might be apparent externally, a point of importance in the recognition of these tumors at operation. In the smaller sessile tumors, the mucosal and muscular layers seemed to be displaced about equally in the opposite directions (Fig. 6). As the tumors became larger, by virtue of the intra intestinal pressure, the wall of the bowel was pushed outward, the serosa of the encircling wall came in contact with the serosa overlying the base of the tumor (Fig. 5), and the two serosal layers became adherent and separated the layers of muscle which seemingly had been enfolded, or pulled in by the drag of the tumor. Such infolding has been described in all three cases in Group 1 and in Case 20 in Group 2. This arrangement provides a possible explanation of the conditions observed in some of the cases, which leads to a description of the tumor as one arising in the muscular layer. Of the lipomata which caused symptoms, those of the small intestine were smaller than those of the large intestine as a rule. Most of the tumors which cause symptoms in the small intestine are about 4 centimeters in diameter, and a few are from 5 to 10 centimeters in diameter, those of the large intestine are usually from 5 to 10 centimeters in diameter, although sometimes they are smaller. Twenty three lipomata were felt by abdominal palpation. The smaller size of those in the small bowel partially explains why only three were palpated. Of the symptomless tumors, the sizes noted vary from an almost microscopic swelling to about 15 centimeters in diameter. The size of the tumor, as well as its situation, seems to determine the time of the appearance of symptoms.

The shape varies with the type of attachment and size. If it is attached by a fibrous pedicle, the tumor may be oval, or it may be flattened and elongated. The pedicle varies markedly in length. If the lipoma is attached by a broad base, with the lipomatous structure separated from the muscularis only by the capsule, the tumor may vary in shape from that of a disk to that of a pear. They may have rounded and smooth, or irregular and lobulated surfaces.

The presence of a considerable amount of adipose tissue beneath the mucosa, in the fold of the ileocecal valve, in Cases 23, 24, 25, and 26, of Group 2, which were observed at the clinic, is to be noted. It is an impression that such depositions of fat are not infrequently encountered at necropsy. A study of the sites of formation of adipose tissue in the various parts of the intestinal tract might reveal the ileocecal valve to be a common one. However, only two

clinical cases of lipoma of the ileocecal valve have been recorded, one (reported by Brouwer) was a pedunculated tumor attached to the valve, the other (reported by Compton) was a diffuse thickening comparable to that in Group 2.

Submucous lipomata were associated with subserous lipomata in 7 instances in this series. They were attached at the same or different points of the wall of the bowel, and might both be sessile and pedunculated, or one might be pedunculated and the other sessile. There might be multiple tumors of both types in the same case. The muscle layer may be intact (Vaccari) or partially destroyed so that the tumors are continuous (Forster). In the latter instance an intramucosal origin may be postulated.

If a lipoma is of sufficient size, it leads to the development of associated anatomical, pathological, and physiologic pathological conditions. Irregular and forceful peristalsis, obstruction at the pylorus and of the intestine, ulceration, intussusception, which no doubt is preceded in many instances by dimpling of the wall of the bowel, spontaneous expulsion, and circulatory changes, results of pressure incidental to forceful peristalsis or intussusception. The tumor itself may be traumatized by a foreign body, with ensuing ulceration. The healed scar in Degener's case may have been the result of such trauma, although that an ulcer might occur on a lipoma, as well as any other ulcer might occur in the duodenum, must be considered. The healed scar in Case 3, Group 1, similarly could have been due to external trauma or to internal hemorrhage.

Intussusception occurred 26 times as a complication in the 29 cases of lipoma of the small bowel in which data on this point were available. In the large bowel it occurred in 33 of 62 cases. The intussusception accounted for 24 of the 47 abdominal tumors that were palpated in the 114 cases with symptoms. The apex of the intussusception reached a point low enough for the tumor (usually attached to the apex), that grew from the wall of the sigmoid or higher segment of the bowel, to be palpated by the examining finger or to be extruded from the anus, in 14 instances. In the case of this sort, which Stetten recorded, the tumor was ileal, in the majority of instances, the tumor was attached to the sigmoid or descending colon. Eight rectal tumors lent themselves to examination by the finger or, after extrusion, to inspection by the naked eye. Spontaneous expulsion occurred 12 times. It is to be noted that this has occurred in only 2 cases (45, 84) since 1909. Early diagnosis and

surgical interference probably accounts for the recent rarity of this complication

Interference with the circulation of these tumors leads to oedema, congestion, ulceration, hæmorrhage into the substance of the tumor, infiltration with leucocytes, and necrosis. The mucosa may be completely or partially absent, necrotic or ulcerated. These changes may lead to marked swelling of the tumor, as illustrated in the difference in size of the tumor at the first and second stages of resection in Case 3, Group 2. This offers an explanation for obstructive symptoms not explainable on the basis of size of the tumor. Cystic degeneration of the tumor has been described. Hæmorrhage from the tumor or from the wall of the bowel, congested and necrotic by virtue of the process of intussusception, explains the presence of the blood so frequently reported in the stools.

Symptoms. Balfour and Henderson have pointed out that benign tumors of the stomach are symptomless unless complicated by bleeding, ulceration, or intermittent obstruction at the pylorus, or unless there is interference with gastric motility and secretion due to the size and extent of the tumor. The 5 cases of gastric lipoma causing symptoms which have been recorded indicate that this is true of gastric lipomata as well as of other types of benign tumor of the stomach. In Fischer's case, the symptoms were those of ulcer, hæmorrhage, and tetany. The chief complaint in Spitzmueller's case was pain brought on by exercise and excitement, and the palpable tumor. The description of the pain suggests angina so strongly that the relief by operation causes some astonishment. The lipoma reported by Randisi definitely produced pyloric obstruction, probably of the half-valve type. The distress in the left portion of the epigastrium, which was worse when the stomach was empty, the occasional vomiting, and the frequent diarrhoea in Weicker's case can be explained by disturbances of motility due to the large size of the tumor. Repeated hæmorrhage and vague symptoms like those of ulcer in White and Judd's case were obviously due to the ulceration on the surface of the tumor. In addition are the 2 cases which came to necropsy, reported by Benaky, and in which pyloric obstruction evidently had been produced, and the case reported by Nahm-macher, in which there was a depressed scar on the surface of the lipoma, suggesting the possibility of previous hæmorrhage.

Stetten assumed that the lipomata passed spontaneously in the cases of Lewtas and Ward were of duodenal origin. Biliary colic was simu-

lated in these 2 cases. Degener reasonably assumed the site of a healed ulceration in the mucosa of a lipoma to be the source of recurrent melæna. In a postmortem examination reported by Nattan, Larrier, and Roux, a duodenal lipoma, the diameters of which measured 6 and 3 centimeters, was associated with dilation of the stomach. The absence of proved cases of lipoma of the duodenum which produced symptoms relegates a consideration of such symptoms to the field of speculation. However, the cases of Lewtas, of Ward, of Degener, and of Nattan, Larrier, and Roux, as well as analogous cases of benign tumors of other types, makes it more than probable that hæmorrhage, pain, symptoms of obstruction, and even ulcer syndromes of a sort, in time will occur in cases of lipoma of the duodenum.

Various authors have attempted a classification of the symptoms of submucous lipoma of the intestinal tract. However, a review of the cases herein reported and of the abstracts of the 111 clinical cases hitherto reported fails to reveal any syndrome peculiar to the lipoma. The symptoms are those of intestinal obstruction. The obstruction exists by virtue of the tumor encroaching on the lumen of the bowel (Cases 2 and 3, Group 1), or by virtue of intussusception (Case 1, Group 1). All varieties of intestinal obstruction are encountered: acute, subacute, chronic, chronic or subacute with exacerbations, partial or complete, progressive or intermittent, and so on. The actual onset of symptoms of obstruction may be preceded by months and years of gastric and abdominal symptoms too slight to induce the patient to seek relief, and too vague to point the way to a diagnosis. The occurrence of the pain at certain hours after meals may suggest peptic ulcer. Appendicitis is simulated especially by the cæcal lipomata.

Diagnosis. A diagnosis of submucous lipoma of the gastro-intestinal tract will be made rarely. In the stomach, the lipoma may be identified as a benign tumor. The history does not often assist in the differentiation of benign and malignant lesions. Roentgenology now furnishes the best means of diagnosis of benign tumors. Balfour and Henderson found that in their series of benign tumors of the stomach, 40 per cent were reported by the roentgenologist as benign. Moore has pointed out the roentgenological signs of benign tumor which distinguish it from malignant tumor. There seems, however, to be no method by means of which the lipoma may be distinguished from the other benign lesions of the stomach.

The same difficulty, although a greater one, exists in the small and large bowel. There the clinician will be content, through necessity, with a diagnosis of an obstructing lesion of the small or large bowel. In every case, reviewed from the literature, with the exception of those in which the growth was seen on examination by rectum, the clinician probably has encountered the same difficulty in reaching a diagnosis which was encountered at the clinic. An attempt may be made to establish whether the lesion is malignant or benign. The long duration of symptoms, as in the cases of Tromp, Braun, and Forster, or the finding by roentgenological methods of a polypoid lesion, may suggest a benign tumor. However, the most common benign polypoid lesion of the colon is the adenomatous polyp, its marked tendency to malignant degeneration renders valueless the assumption that a polypoid lesion is benign. The occurrence of 72 per cent of the lipomata in patients of cancer age, the frequently associated loss of weight, and the frequent appearance of blood in the stools do not aid in the attempt to establish the polypoid lesion as a benign neoplasm. If the tumor can be established as being benign, a lipoma may be thought of, especially, as Albrecht suggested, if the patient is obese or if lipomata are present elsewhere. Meyer mentioned that a soft tumor palpated through the abdominal wall suggests a lipoma. The value of the point is doubtful.

Only when a tumor is rectal, or when it prolapses into the rectum or through the anus, will it be possible to make a definite pathological diagnosis. The following characteristics will point to the nature of the tumor: softness and lobulation of the tumor, elicited by palpation, the yellowish tinge of the mucosa or of the area of surface denuded of mucosa, when the growth is seen externally or through the proctoscope, will point to the nature of the tumor. However, the changes secondary to circulatory disturbances may so alter the lipomatous consistence, color, and structure that recognition of the condition would be impossible even with the aid of biopsy.

At operation the benign character of the growth has been suspected because of the consistence of the tumor, its pear shape, its broad base of attachment, and its yellow appearance as seen through the muscle covering its base. In some instances, excision instead of resection has been carried out, with reduced risk to the patient.

SUMMARY

Three submucous lipomata of the colon which produced symptoms, and which were removed

surgically, and 25 which did not produce symptoms and were found incidentally at operation or necropsy, have been presented from the records of The Mayo Clinic.

Abstracts of reports of 68 cases previously reported and not included by Stetten or by White and Judd are given.

A total of 181 submucous lipomata are available for study. Of these, 114 produced symptoms and 67 did not produce symptoms.

Submucous lipomata form one of the more important subdivisions of benign gastro-intestinal neoplasms. Clinically, they rank in frequency with myomata, are less common than the adenomatous polyp, and more common than the other types of tumor in the small and large bowel, in the stomach, they are apparently among the least common of benign neoplasms.

They seem to occur more commonly in the stomach and duodenum, and in the lower part of the ileum, the cæcum, and the ascending colon, and twice as commonly in the large as in the small intestine.

They occur singly or multiply, sessile or pedunculated, in association with the subserous variety, and equally as commonly in male and female.

The symptoms are those of irregularity in force and rhythm of peristalsis, obstruction of the stomach, especially at the pylorus and of the small and large bowel, intussusception, and ulceration incidental to the circulatory changes wrought by pressure and intussusception or caused by external trauma.

The diagnosis of a lipoma of the gastro-intestinal tract has been made before operation only in exceptional instances, the diagnosis usually cannot be more accurate than that of benign tumor.

A definite diagnosis of lipoma can be made only under certain conditions: (1) when the tumor can be seen through the proctoscope or after it has prolapsed externally, and the appearance then is typical, and (2) when biopsy can be made from a rectal lipoma or from a lipoma attached to the apex of an area of intussusception which prolapses into the rectum.

The occurrence in patients who are within the cancer age, of 72 per cent of the lipomata which produce symptoms, as well as the often short duration of symptoms of loss of weight and blood in the stools may readily suggest the presence of a malignant process.

The consistence, the shape, the broad base of attachment, and the yellow of the fat shining through the muscular layer may in some instances suggest the character of the tumor to the operator.

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EDITORIALS

SURGERY, GYNECOLOGY AND OBSTETRICS

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WILLIAM J. MAYO, M D

Chief of Editorial Staff

JANUARY, 1931

THE MEDICAL TREATMENT OF CANCER

AS Lord Moynihan has tersely stated, cancer is a dirty fighter, and one out of every seven persons aged more than thirty-five years dies of the disease. If for the moment we disregard those patients who are operated on for cancer early in the course of the disease, or those who are cured by radiotherapy, we may say, with regard to the average of the population, that 10 per cent have cancer and 90 per cent do not. Cancer never develops in sound tissue. And as the evidence available, both clinical and experimental, is analyzed, there is a strengthening conviction that cancer is not caused by some influence outside the body but by changes that take place within the body, and that the 90 per cent of persons are sufficiently well protected against the ordinary local disturbances which may produce cancer, if they are susceptible, to prevent the disease. We must assume that such protection through natural resistance is not always of the same degree because whereas the disease may develop after a brief precancerous phase in

certain persons who are extremely susceptible, it may develop in others only after a prolonged stage of chronic irritation.

Broders' classification of cancer, based on the criteria established by the early work of Wilson and MacCarty, makes possible a graphic conception of the disease. The less malignant types in Broders' classification, grades 1 and 2, may indicate higher resistance, and the more severe types, grades 3 and 4, lower resistance, rather than that the severity of the disease indicates a difference in the causes which led to it. If we had some way of measuring the resistance of the individual to cancer, it might even be possible to look forward to the time when low resistance could be raised.

Growing embryonic cells of the chorionic villi (Langhan's cells) resemble malignant cells in rapidity of division and growth. The cancer cell, notwithstanding its power of rapid growth, lacks the strong heredity of the Langhan's cells, and is much more susceptible than the normal cell to destructive influences. If we analyze cases of cancer clinically, we find that the chief causes of pain and distress are the involvement of nerves, interference with the function of a viscus, and infections due to the breaking down of cancerous tissue.

It has long been known that cancer in a relatively sterile situation, which does not involve nerves and has room for expansion without serious pressure on other organs, for instance, cancer in the liver, can grow to great size without causing the patient much discomfort. Other things being equal, if a patient has an early cancer of an organ, for instance of the rectum, threatening as it does

painful death from involvement of the bladder and genitalia, and infection, if the growth can be removed without too much risk, it should be done even in the presence of incurable secondary involvement elsewhere in the body. The life of the patient will thus not only be prolonged but made more bearable during the terminal stages.

One of the methods by which the body offers resistance to cancer is encapsulation of the cancer cells in connective tissue, which acts as a protective mechanism to prevent further spread. The cancer cells, however, may remain for years in such hibernation, only to break loose at some future time.

It has been suggested especially by those who work with pulmonary tuberculosis, that if the primary lesion can be removed, the secondary growth often is delayed in its activity by an immunizing process, an increased resistance of the patient's protective mechanism, and perhaps this is as true of cancer as of tuberculosis.

In speaking of the medical treatment of cancer, therefore, one is not thinking of cure but of those measures of palliation which may aid in increasing resistance as well as bringing about destruction of the cancer cell. Are we prepared to say that there are no medications that will delay the progress of cancer or increase the resistance of the patient who already has the disease?

Arsenic given internally was believed at one time to increase resistance and delay the growth of cancer. The use of colloidal lead and colloidal gold by skilled observers has appeared to have some such effect. What we need is a survey of these possible methods of giving relief to see whether there are means of increasing the resistance of the patient to the disease, and at the same time a survey of the effects of surgery, radiotherapy, and any or all agents which in the past or in the present

have the reputation of being valuable in the treatment of cancer. Although the medical profession looks with skepticism on any unscientific form of treatment of cancer it is sufficiently open minded to view without prejudice any form of treatment which may have value.

W. J. MAYO

POSTOPERATIVE LUNG COMPLICATIONS

WITH the steady decline in the mortality and morbidity following surgical operations, the importance of postoperative lung complications tends to increase, since on the whole they have not diminished in the same ratio. These conditions should be thought of as postoperative rather than postanesthetic since it is quite clear that they, at least, are not entirely due to the anesthetic though undoubtedly anesthesia is a factor, sometimes the important factor. It is probably true that such complications are more common after the use of ether, but it is quite certain that they occur no matter what anesthetic is used and that they are not uncommon where the anesthetic has been regional or even local in type. It is notable that they are more common and more severe in connection with abdominal operations and particularly operations upon the upper abdomen. The incidence following operations upon the chest wall or the lung itself should not properly be included. Despite the large amount of work which has been devoted to the assignment of the various causative factors, there is as yet no general agreement. Among the causes certainly at times operating to cause these conditions may be listed (1) inhalation of irritating or foreign substances, (2) irritation from the anesthetic itself probably most commonly associated with ether, (3) emboli, and finally (4) atelectasis, a cause which has commanded increasing

attention and which is probably a very important factor

Atelectasis probably arises commonly from the following sequence of events Mucus collects in the smaller bronchi, respiration is slowed, and its depth diminished sometimes by medication, sometimes by the anæsthetic, and finally, particularly in connection with operations on the upper abdomen, respiration is voluntarily restricted because of pain Of these factors the slowing of respiration is becoming increasingly important in connection with some of the newer anæsthetic methods Thus the administration of various of the harbituric acid derivatives, and the increasing use of spinal anæsthesia accompanied by pre-anæsthetic medication with morphine and other drugs tend to create a larger group of patients in whom respiration is slowed over a considerable period of time quite apart from the conditions incident to the operation At least a good case has been made for the proposition that atelectasis is a very important factor in many of the postoperative lung complications and if this be true, it is of essential importance that it should be counteracted by appropriate means Particularly the work of Henderson has shown that the administration of carbon dioxide will do much to relieve the early conditions leading to atelectasis It is doubtful whether the im-

portance of this work has been sufficiently generally recognized and whether the administration of carbon dioxide after surgical operations, and particularly in patients in whom there is any tendency to slowing of the respiration, is becoming a routine procedure Many anæsthetists have made it a practice to conclude the inhalation anæsthesias with the administration of carbon dioxide and this is undoubtedly desirable On the other hand, the conditions giving rise to atelectasis can probably not be done away with by a single administration of this kind It is at least worth while to consider whether the routine administration of carbon dioxide two or three times in the twenty-four hours for the first two days following operation is not sufficiently desirable to be incorporated as a regular practice in our surgical routine My own experience in the past year seems to indicate that the routine administration of carbon dioxide has very importantly diminished the number of postoperative lung complications and since the method is quite harmless and unobjectionable, a much wider adoption of the method would seem desirable I incline to the view that the postoperative use of carbon dioxide is the most important single contribution to the ultimate safety of anæsthesia which has been made in many years

HUGH CABOT

MASTER SURGEONS OF AMERICA

WILLIAM GIBSON

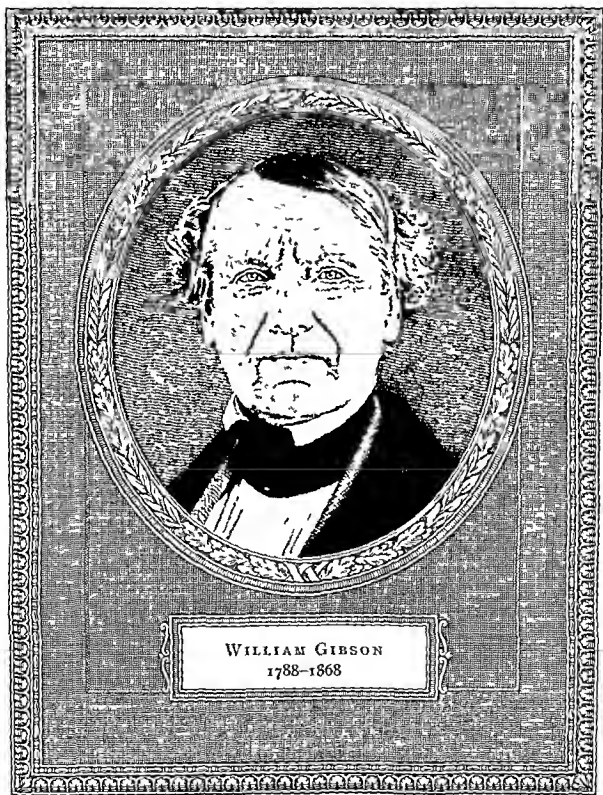
A GREAT teacher and a great surgeon was William Gibson. He was born in Baltimore, in 1788, and as his parents were well to do they were able to give him every educational advantage. As a youth he attended Annapolis College and later he entered the sophomore class at Princeton.

In the winter of 1806-1807 he attended the surgical lectures of Professor Physick in Philadelphia. Like other men of attainment, he early appreciated his own latent capacity. One day after Physick's lecture he seemed abstracted and thoughtful, and when questioned by his fellow students answered that he expected some time to succeed the great Physick. Thirteen years later this actually happened.

When the Physick lectures were concluded, Gibson sailed for Europe and entered the University of Edinburgh. His graduation thesis in Latin, "*De Forma Ossium Genitilitæ*," evoked favorable comment. Soon after he visited London and became a member of the household of Sir Charles Bell, for whom he conceived a profound admiration. He considered Astley Cooper great, but Bell even greater. Indeed, one of his sons was named Charles Bell and he subsequently became a distinguished surgeon. While in London, Gibson had the opportunity of seeing many of the wounded after the battle of Corunna. Some of his biographers state that receiving news of the impending battle he managed through influential friends to board a British transport and was present during the engagement.

In 1810 he returned to Baltimore. In 1811 he married for the first time, and by this marriage had five children, three sons and two daughters. By a second marriage he had two more daughters.

In 1812, during the riot in Baltimore, he saw a man fall from a gunshot wound in the groin. There was a profuse hæmorrhage which Gibson checked by digital compression. He then immediately obtained assistance, exposed and tied the common iliac artery, found that the distal end of the torn artery also bled, and closed two holes in the intestine. The wound was then held together with adhesive plaster, but the patient succumbed to peritonitis on the fifteenth day, from intestinal leakage. The lower extremity remained viable. This was the first demonstration of the establishment of collateral circulation of the lower extremity after ligation of the common iliac.



WILLIAM GIBSON
1788-1868

The same year Gibson operated on General Winfield Scott, who had been wounded at the battle of Lundy's Lane, near Niagara Upon removal of the embedded bullet the persistent sinus in the leg healed

About this time Gibson organized the medical department of the University of Maryland, and became the first professor of surgery in this school In September, 1819, however, he was appointed to the chair of surgery at the University of Pennsylvania, which he occupied for thirty-six years At this time his old friend Professor Physick, who because of ill-health had retired five years before after occupying the chair of surgery for twenty-seven years, was recalled to the chair of anatomy

In 1824, Gibson's textbook, *The Principles of Surgery*, dedicated to Physick, made its first appearance It was the standard work of its time and eventually ran through eight editions

Gibson was the first to introduce systematic clinical instruction, always stressing the principles of his work One of his biographers says "He had a chaste, offhand style of lecturing If the eyes were shut it was like reading a book " He successfully performed a cesarean operation twice on the same patient with complete recovery (1835-1837)

In 1811 he devised linear extraction of cataract In 1818 he operated for strabismus, twenty-one years before Dieffenbach He was the first to perform suprapubic lithotomy He devised a circular saw actuated by clockwork, for the cutting of bones He had the courage to report two cases of rupture of the axillary artery following attempted reduction of dislocated shoulders

In the summer of 1839 Gibson again visited Europe and in 1841 this visit was described in a book of 390 pages, *Rambles in Europe in 1839* This is a charming work with faithful descriptions of the great medical centers in London, Paris, Edinburgh, and Dublin It is remarkable to note how little the essential spirit of these great centers has changed since that time The notables of the period live and move across the scene as one reads the book

Gibson's amusements were hunting, taxidermy, fishing, and carpentry He was very fond of music and played the violin For over sixty years he faithfully kept a journal, which reached the imposing number of 150 volumes His accuracy was so well known that occasionally he and his journal were called upon to determine the exact date of some occurrence or the state of the weather on a certain day

He was a man of strong character and equally strong prejudices He was violently opposed to the use of tobacco and was once vice-president of the Anti-Tobacco Society of London He repeatedly stated that he had added twenty years to his life by not smoking He was an excellent observer and correctly stated that men got along more by tact than by talent But he was not amiable As an example, it is related that after twice warning a noisy young son at the

table to be quiet, he finally impaled the child's foot to the floor with the carving fork, remarking, "Now, will you be still?"

He was somewhat vain and on his return from his "Rambles in Europe" appeared before his class in a loud suit of shepherd's plaid, which occasioned much cheering from the students. This he took as personal acclaim, though it was really intended for his startling garb.

He was passionately fond of fishing. Indeed, it was while on one of his fishing trips, in his eightieth year, that he died, from what may be supposed to have been senile gangrene of the foot.

Years before, while on a fishing trip accompanied by a lawyer friend, he had an altercation with another man over a boat, and beat him up severely. His friend the lawyer defended him in the ensuing action brought against him and to Gibson's surprise rendered a bill for legal services, which was paid without comment. Shortly after another fishing trip was undertaken with the same legal companion, and as the result of some tartar emetic slyly added to the luncheon the lawyer became violently sick. He was attended by his medical friend, who then rendered his bill for an amount identical with that which had been charged by the lawyer.

William Gibson was one of the great figures of his time—a talented, energetic surgeon of great capacity, sound judgment, and clear vision. His literary ability was considerable. His qualities of intellectual honesty and energy greatly overbalanced any irascibility which he sometimes displayed. JOHN C. A. GERSTER

[The page contains dense handwritten text in Arabic script, likely from a manuscript. The text is written in a cursive style and covers most of the page area.]

THE SURGEON'S LIBRARY

OLD MASTERPIECES IN SURGERY

ALFRED BROWN M D FACS, OMAHA

THE OLDEST SURGERY IN THE WORLD

EVER since surgical history has been written authors have harked back to Hippocrates and the ancient Greeks for the starting point of real surgery. Occasionally one more daring has gone back half a millennium or so further and pointed out the mention of surgical facts in the works of Homer. Beyond that, we, from our self appointed pinnacle of modernity, have considered and freely stated that all was mysticism, supernaturalism, and belief in implantation of diseases by the gods with nothing but the recipe books of the magi and others to guide the poor benighted in their search for health.

We have felt so secure in this opinion that our ideas have become fixed and we have stated as facts matters which were actually only suppositions. In fact we are in a position where our whole conception of surgical history must be made over.

Professor Breasted with his translation of the Edwin Smith *Papyrus*¹ and its publication by the Chicago University Press compels us to discard all our previously held ideas and build for ourselves a new chronological conception of the development of surgery. Instead of Hippocrates being the originator of surgical method and surgical description he is, according to the time in which the author of the Smith *Papyrus* lived, actually as much of a modern to that surgeon as we are to him. Consequently we must move Hippocrates from the far background of our picture of surgical history and allow his place to be taken by this unnamed Egyptian surgeon men while moving Hippocrates to the most prominent place in the middle distance.

If we make this change in our picture, and for the sake of truth, it must be made, how are we to fill in that space between the background and the middle distance? At present, save for the Assyro-Babylonian fragments, the few Egyptian recipe books, the record of the magnificent work of Moses along the line of sanitation and health prevention, and the ancient Indian works, if they antedate Hippocrates and there is some doubt if they do, there is nothing except the surgical portion of the *Papyrus Ebers*, that can be used to fill in this period of twenty-five hundred years, and further discoveries must be awaited until any definite data can be obtained.

In the meantime the Smith *Papyrus* furnished definite evidence that the general trend of surgical didacticism which has held the stage to the present was then, nearly five thousand years ago, an established method. The author of the original book was evidently a practicing and practical surgeon whose method of teaching was by the citation of case histories. In the fragment which constitutes the Smith *Papyrus* forty-eight cases are cited. These begin with cases of head injury and proceed downward toward the feet including in turn throat and neck, clavicle, humerus, sternum, overlying soft tissue and true ribs, shoulders, and upper spinal vertebrae. Here the manuscript stops and as Breasted puts it referring to the scribe who wrote the *Papyrus*, "One can imagine him yawning, rising indifferently and going home to his dinner, quite unconcerned, and altogether unaware of the fact that he was leaving the future civilized world entirely without any knowledge of his great ancestor's cases on the surgery of the internal organs, which in all likelihood followed immediately on that of the spine." In the *Papyrus* is found the arrangement of teaching material anatomically from head to foot which was so commonly used later and which in some textbooks of anatomy persists today.

The knowledge shown by this ancient surgeon was considerable. As examples: He describes paralysis of one side of the body following injury of the brain, and notes the shuffle of one foot after such an injury. He reduces a dislocation of the mandible by placing the thumbs on the jaw and forcing the condyloid processes back into position, and an extremely important fact is that he counts the pulse. That he was a scientific observer aside from a mere "healer" is shown by the fact that in sixteen of his examinations he advises against treatment, considering the case hopeless. In spite of this he takes enough interest in the diagnosis to note the symptoms and signs even though he prescribes nothing. He repeatedly advises his readers to let nature do the work and in this again precedes the Hippocratic ideas.

Students of surgery are greatly indebted to Professor Breasted for furnishing this most important work in readable form and students of medical history have now a tremendous task before them to fill in the gap left between Hippocrates and the unknown Egyptian surgeon who wrote a book which may have been the famous "Secret Book of the Physician" to which the *Papyrus Ebers* refers.

¹The Edwin Smith Surgical Papyrus. Published in Facsimile Hieroglyphic Transliteration and Commentary. By James Henry Breasted. Vols. 1 and 2. Chicago: The University of Chicago Press 1930.

REVIEWS OF NEW BOOKS

DURING the past decade, few fields of medicine have been as thoroughly investigated as that of the stomach. The reports of physiological investigations, clinical studies, and various therapeutic and surgical procedures are offered to the medical profession in such profusion that the untrained medical man becomes bewildered and the proficient practitioner becomes skeptical. In all this maze of information there must be much tangible and useful information which the medical practitioner and surgeon can and should utilize in his daily practice but to cull the world's literature with a critical eye and discerning mind is a momentous task, moreover, in order to accomplish this task the worker must have independently acquired much knowledge and experience in order that he may choose and advise wisely. By no means all or even the greater part of stomach and duodenal pathology or disturbed function is based on peptic ulcer, yet peptic ulcer has been the subject of more study than possibly all other specific lesions of the stomach and duodenum; therefore a critical summary of this investigative work is most welcome. The recent work by Hurst and Stewart¹ cannot be alluded to as such a compilation but rather as an elaborate and complete monograph on Gastric and Duodenal Ulcer. The authors take cognizance of most of the essential work that has been done on the subject and present it in a correlated form which is concise and applicable.

Many chapters have unusual points of interest, the romance of gastric ulcer is presented for those interested in such topics. Stewart, from the viewpoint of a pathologist gives an unusually lucid description of the pathological anatomy of ulcer. This is followed by Hurst's description of the pathological physiology and an explanation for the cause of pain and tenderness in gastric and duodenal ulcer. This sequence with its conclusions is most convincing. The chapter on radiological investigation is strikingly well illustrated and many significant diagnostic and technical points are presented.

The authors express marked conservatism in recommending direct surgical interference but advocate the removal of all foci of infection and careful and prolonged medical treatment. Their belief is that by far the largest percentage of peptic ulcers will heal and remain healed under this regimen. The presence of occult blood in the stools is stressed and the authors believe that this finding is a fairly accurate criterion of the healing process of the ulcer. They also offer it as a possible differentiating point between simple ulcer and early carcinoma.

Here again the chapter on ulcer cancer is most interesting and illustrates the care and precision which characterizes the preparation of the entire work. In the discussion of jejunal and gastrojejunal ulcer many pertinent points are presented.

The American reader may be doubtful of the possibility of the high percentage of permanent cures from medical treatment but there is a decided question as to whether in America medical treatment is carried out in detail and over the entire period of the patient's life as advocated by Hurst. The reader acquires the impression that the authors hold that the removal of all foci of infection and care in diet during the remainder of the patient's life are the two all important factors in the permanent cure of peptic ulcer.

This monograph of some 500 pages is beautifully illustrated, worded in excellent English and presents all aspects of peptic ulcer in a thoroughly scientific yet practical manner. It is a credit to the medical profession and a welcome addition to the library of the medical adept.

J. A. WOLFF

THE author states that the purpose of his book² is to furnish the student with a correct introduction to the technique of physical examination and diagnosis of the lungs. There is little new material but most of the salient points of chest examination are concisely and systematically placed. There are only sufficient illustrations and hypothetical problems to bring out the more important diagnostic points which are lost to the beginner in the larger books on this subject. The book should be of great help to the interne.

ALFRED HARRIS

THE volume³ by Prof. Volz really constitutes his report as secretary of the subcommittee of the Radiological Commission of the League of Nations and deals with carcinoma of the uterus and the vagina. This report was made as part of the work of the Sanitary Division of the League of Nations and owed its initiative to the president of the Cancer Commission, Sir George Seaton Buchanan. A foreword is included from the pen of Dr. A. Doederlein of Munich. The book deals with historical data, technical methods, and final results in the treatment of cancer of the female genital organs, based upon more than three thousand cases treated in the Doederlein Clinic in Munich. Further data are drawn from the work of Dr. J. Heyman of Stockholm, Dr. A. Lacassagne, of Paris, and Prof. Cl.

¹PROCEDURE IN EXAMINATION OF THE LUNGS, WITH SPECIAL REFERENCE TO THE DIAGNOSIS OF TUBERCULOSIS. By Arthur F. Hurst and M. D. Stewart. New York: Oxford University Press, 1930.

²SONDERE VERDEKZ SWAHLNTERAPIE, VOL. XIII—DIE SWAHLN BEHANDLUNG DER WEIBLICHEN GENITALCARCINOM. MIEBOWEN UND ERGÄNZE. By Professor Dr. Friedrich Volz. Foreword by Prof. Dr. Albert Doederlein. Berlin: Urban und Schwarzenberg, 1930.

³GASTRIC AND DUODENAL ULCER. By Arthur F. Hurst, M.A., M.D. (Oxon), F.R.C.P., and Matthew J. Stewart, M.B. (Edinb.), F.R.C.I. Radiological Sections by P. J. Riggs, M.A. (Cantab), M.R.C.S. L.R.C.P. New York and London: Humphrey Midford Oxford University Press, 1929.

Regaud, of Paris. The book is full of valuable facts regarding both the roentgen and the radium treatment of genital cancer and should stimulate further and more accurate work in the campaign against this disease.

JAMES T. CASE

THE first half of volume VI of Stoeckel's *Handbuch der Gynaekologie*¹ is in keeping with the first volume previously reviewed—it is a most thorough and complete reference book on gynecology, complete in every detail and most profusely and well illustrated. Von Franke writes the section on the anatomy, histogenesis, and anatomical diagnosis of cervical and uterine carcinoma. The pathology of cervical and uterine carcinoma, hydatid mole, and chorio epithelioma and endometrioma by Robert Meyer is written in the same careful and painstaking manner that characterizes all of Robert Meyer's writings. Of special and timely interest is his presentation and discussion of all the various theories pertaining to the histogenesis of endometriosis.

Hinselman, of Altona, contributes the section on the etiology, symptomatology, and diagnosis of cervical and uterine carcinoma and of chorio epithelioma. The description of the colposcope developed by the author and the many illustrations of the views of cervical pathology obtained by means of the colposcope are especially valuable.

The same criticisms hold for this volume as for the preceding ones, namely that the work gives promise of being too large for anything other than a library reference work and further too much space is devoted to bibliography—100 pages out of a total of 1,100. This seems out of place in a "Handbuch."

RALPH A. REIS

THE ninth volume of the Oxford *Monographs on Diagnosis and Treatment*² is an exceedingly valuable aid to the practitioner in the difficult and common clinical problems raised by abnormal conditions of the blood. Great advances have recently been made, which are thoroughly set forth in this work. The early diagnosis of pernicious anemia has become more worth while. The details of this diagnosis are described. Certainly a broader study is now necessary for this diagnosis, withholding it until the extreme anemia is present may do irreparable harm to the spinal cord. The Price Jones method of studying anisocytosis is illustrated. The unusual leucocyte responses to infection are described in chapters on agranulocytic angina and glandular fever. The typical and atypical leukemias are given full description. Two features make this

work unusually useful, namely, chapters on the blood in systemic diseases and pregnancy, and a full section on the anemias of childhood by Blackfan and his associates. Every chapter is completed by two or three pages of references, making in all an extensive bibliography on diseases of the blood. The colored illustrations of typical blood smears are perfectly done.

PAUL STARR

LIKE others in the series of Harper's *Medical Monographs*,³ Norris' monograph on uterine tumors is a concise and well written summary, useful alike to the practitioner and to the student. Norris has presented the salient aspects of the subject in a manner that should appeal to every gynecologist. His discussion of carcinoma is particularly valuable in its accurate and detailed consideration of the factors of predisposition, growth, differential diagnosis, and treatment. An excellent classification of types of tumors, their incidence, and the stages of advancement are given. The book deserves special commendation as a readable, up to date, and instructive description of uterine tumors.

MARK T. GOLDSTINE

WHITE, in his recent book on *Cancer of the Breast*,⁴ gives us a clear, concise treatise on the subject. He takes up the fundamentals of anatomy, physiology, and pathology, and deals with them from the standpoint of treatment. The chapters on signs and symptoms and differential diagnosis of tumors of the breast and classification of malignancy, are written with a view to being instructive and practical to the student. Of more than usual interest is the classification, in that the author has given us some detail of the microscopic grading of malignancy by Broders, MacCarty, and Greenough.

The chapters on the roentgen ray and radium therapy are taken up from the standpoint of technique and the application of the principles of treatment as applied to the various types of the disease, with some of the hopes, the limitations, and the indications for the use of this therapy.

The author recommends early recognition and early and thorough removal, and he stresses the principles of Handley in cutting close to the skin without destroying its blood supply, and superficial to the deep fascia.

To the student of surgery, the chapter on types of surgical procedure is of interest in obtaining detailed information relative to modern accepted principles as laid down by prominent general surgeons. The discussion of pathological examination includes a minute detailed consideration from the standpoint of the gross, the microscopic, frozen section, and the Terry method.

¹HANDBUCH DER GYNAEKOLOGIE Vol. VI first half—ANATOMIE UND DIAGNOSTIK DER CARCINOME DER EINGEGANGENSGESCHLECHTER UND AUSGESCHWULSTE DES UTERUS DER BLASSENHÖHLE UND DER CHORIOEPITHELIOLOMA MALIGNITÄT. By Otto von Franke H. Hinselman and Robert Meyer. Munich J. F. Bergmann 1930.

²OXFORD MONOGRAPHS ON DIAGNOSIS AND TREATMENT. Edited by Henry A. Christian M.D. Sc.D. LL.D. Vol. IX—THE DIAGNOSIS AND TREATMENT OF DISEASES OF THE BLOOD. By Thomas Ordway, M.D. and L. Whittington Gorham. New York and London. Oxford University Press 1930.

³UTERINE TUMORS. By Charles C. Norris M.D. New York and London. Harper & Brothers 1930.

⁴CANCER OF THE BREAST. By William Crawford White M.D. F.A.C.S. New York and London. Harper & Brothers 1930.

The book is very instructive. It should be unusually interesting and can be recommended as being of great help to the student, the practitioner, and the general surgeon and thus fulfills the purpose of the author in presenting a short but rather complete survey of the subject of cancer of the breast.

W A HENDRICKS

THE notes presented in his manual¹ are the result of Reuben Peterson's twenty five years' experience in conducting and supervising the demonstration course in obstetrics.

The book is well gotten up in typewriter lithographic form with alternating blank pages for the students to take notes. The illustrations while few are adequate for the purpose. The book is small, concise, and full of information. The management of the various complications is such that if followed in the average case it would lead to good results.

The book will fill a very useful niche in the teaching of obstetrics and can be recommended to all of the schools as a safe and conservative notebook on the manikin work.

E L CORNELL

THE fact that Dr Ballenger's book² is now in its sixth edition would be enough to recommend it but each edition has improvements and additions over the previous number. The more recent additions have been chapters on broncho oesophagocopy by such noted authorities as Chevalier Jackson and Gabriel Tucker. Dr Ballenger has also added a special chapter dealing with the streptococcus sore throat because he feels that the organism has assumed a rôle of such importance as to justify a more detailed description. The book contains over eleven

¹A MANUAL FOR THE DEMONSTRATION COURSE IN OBSTETRICS. By Reuben Peterson, A B M D F A C S. Ann Arbor Michigan Edwards Brothers.

²DISEASE OF THE NOSE THROAT AND EAR. MEDICAL AND SURGICAL. By William L. Ballenger, M D F A C S. Revised by Howard Charles Ballenger M D F A C S. 6th ed rev. Philadelphia Lea & Febiger 1930.

hundred pages and is printed on good stock with excellent illustrations and clear type. It is a comprehensive one volume treatise on diseases of the ear, nose, and throat, and makes a handy and ready reference besides a good text.

JOHN F DELPH

THE seventh edition of Coakley's manual³ has 672 pages and 13 chapters with 160 engravings and colored plates. The author needs no introduction and his present volume follows in general outline the scheme of his previous manuals. Designed primarily to put into compact form the essentials of diseases of the nose and throat, the author has purposely omitted all controversial subjects and has placed a ready text in the hands of the practitioner. The book is not extensive but contains all essentials necessary to a good textbook.

JOHN F DELPH

THE book by Bailey on *Demonstrations of Physical Signs in Clinical Surgery*,⁴ makes its appearance in a second revised and enlarged edition. The work is entirely complete in that it covers the physical signs of practically every surgical condition. The book is written in a clear, lucid style which is made even more effective through the use of numerous excellent illustrations. The author has accomplished much more than the modest title of the work would suggest. He not only describes the physical signs and how to apply them but he actually teaches diagnosis and differential diagnosis of surgical conditions. The student in his clerkship and dispensary days the interne in his surgical service would find a wealth of practical information to guide him in his formative stage.

GEO HILFERN

³A MANUAL OF DISEASES OF THE NOSE AND THROAT. By Cornelius C. Coakley, A M M D F A C S. 7th ed rev. Philadelphia Lea & Febiger 1930.

⁴DEMONSTRATIONS OF PHYSICAL SIGNS IN CLINICAL SURGERY. 2nd ed. By Hamilton Bailey F R C S (Eng). New York William Wood & Company 1930.

BOOKS RECEIVED

Books received are acknowledged in this department and such acknowledgment must be regarded as a sufficient return for the courtesy of the sender. Selections will be made for review in the interests of our readers and as space permits.

OBSTETRICIA CLINICA Y OBSTETRICIA SOCIAL. By Doctor Augusto Turenne. Montevideo Imprenta Nacional 1930.

A TEXT BOOK OF GYNECOLOGY. By Arthur Hale Curtis, M D. Philadelphia and London W B Saunders Company 1930.

DIE ADVERTINNAKROSE IN DER CHIRURGIE. By Prof Dr W Anschuetz, Dr K Specht Priv Doz Dr G Tiemann. Berlin Julius Springer 1930.

EMERGENCY SURGERY. By Hamilton Bailey F R C S (Eng). Vol I—Abdomen and Pelvis. New York William Wood and Company 1930.

GYNAEKOLOGISCHE OPERATIONSLEHRE. By Dr H v Peham Dr J Amreich. Berlin S Karger 1930.

UEBER DAS PROBLEM DER BOESARTIGEN CYSCHWUELSTE. EINE EXPERIMENTELLE UND THEORETISCHE UNTERSUCHUNG. 2d ed. By Prof Dr Lothar Heidenhain. Berlin Julius Springer 1930.

MEDIZINISCHE PRAXIS, SAMMLUNG FÜR AERZTICHE FORTBILDUNG. Edited by L K Grote A Fromme K Warnekius Vol IX—Blutung und Fluor. By Prof Dr Hans Kunge with a foreword by Prof Dr Robert Schroeder. Dresden and Leipzig, Theodor Steinkopff 1930.

DIAGNOSTICS URGENTS, ANOMALIES. By H Mondor. Paris Masson et Cie 1930.

INTRODUCTION TO MEDICAL DIAGNOSIS AND STATISTICS. By Raymond Pearl 2d ed rev. Philadelphia and London W B Saunders Company, 1930.

SURGERY, GYNECOLOGY AND OBSTETRICS

AN INTERNATIONAL MAGAZINE, PUBLISHED MONTHLY

VOLUME LII

FEBRUARY, 1931

NUMBER 2

EXPERIENCES WITH THE CEREBELLAR ASTROCYTOMAS¹

A CRITICAL REVIEW OF SEVENTY-SIX CASES

HARVEY CUSHING, M.D., BOSTON

I INTRODUCTION

WHAT has been chiefly contributory in recent years to the success of operations for intracranial tumors has been the tendency of those interested in the subject to concentrate upon the behaviour and traits of special tumors in special situations. This was hardly possible when these operations were few and far between, but now that they are of daily occurrence it becomes increasingly evident that tumors of each particular kind occupy favoured sites and evoke a similar and therefore recognizable set of symptoms. This being so, it becomes possible with some degree of assurance to foretell in a large percentage of cases what particular type of lesion will be encountered, what it will look like when brought to view, and what surgical procedure offers the best prospect not only of the immediate amelioration of symptoms, but, in an ever enlarging percentage of cases, of permanent cure.

As an outcome of this change in attitude and with the growing conviction that the point of origin of tumors of different kinds is not purely accidental, it is no longer highly profitable to discuss the effects of brain tumors in general, to describe the symptomatology of tumors in a given region irrespective of their specific nature, or to deal with tumors of comparable histology irrespective of their location.

For this reason, those of us who have been at this business longer than others begin to feel the obligation of handing on from time to time the results of our surgical experience with tumors of particular kinds in particular situations. This sort of information, however, is admittedly difficult to transmit, for though the general principles may be more or less the same, no two of these operations are precisely alike, and in the process of carrying out what at the best is a complicated and often hazardous procedure, unforeseen circumstances may arise which wholly modify its intended course. When to take great risks, when to withdraw in the face of unexpected difficulties, whether to force an attempted enucleation of a pathologically favourable tumor to its completion with the prospect of an operative fatality, or to abandon the procedure short of completeness with the certainty that after months or years even greater risks may have to be faced at a subsequent session—all this takes surgical judgment which is a matter of long experience and which can scarcely be transmitted by the written word.

Surgical judgment, indeed, is a more or less inspirational quality which is variable and elusive, all surgeons being conscious of having it in hand on some occasions, of losing it on others. It is a good deal like a game which even the best and most consistent player fumbles for some unaccountable reason at

¹ Being the basis of the second Arthur Dean Evans Lecture of the Chicago Surgical Society delivered October 3, 1930, before the joint meeting of the Chicago Surgical Society, the Institute of Medicine of Chicago, Chicago Neurological Society, the Society of Internal Medicine, the Chicago Pediatric Society, and the Chicago Society of Medical History.

certain times. The surgery of brain tumors may be likened without being trivial to a form of major sport which is played against an invisible but utterly relentless antagonist quick to take advantage of every misplay and faulty move. And when the time comes to make public one's score, it is done somewhat apologetically, but with the expectation that others may profit by it and with the assurance they will come to improve upon it.

The gliomas in general. All this applies with particular force to the formidable tumors composed of the structural elements of the central nervous system, once looked upon as invariably malignant lesions with a hopeless prognosis. Operative interference was commonly supposed to activate a tumor of this kind and for long the general tendency among surgeons was to leave a glioma, once exposed, respectfully alone. Nor was any encouragement to be had from the standpoint of the pathologist. There is no better contemporary description of the histological peculiarities of the gliomas as a class than the vivid though brief account written by W. T. Councilman in 1915 shortly after the opening of the Brigham Hospital and based on the 115 tumor specimens that had already passed through his hands (1). Not only did he find the lesions hopelessly infiltrative, but so great was their architectural and cytological variation from tumor to tumor—indeed in different parts of the same tumor—that any attempt at classification, which would even serve a convenient purpose, was then looked upon as futile. And when as time passed it came to be appreciated that the gliomas represent something over forty per cent of all intracranial neoplasms, this was taken to mean that approximately half of the surgeon's time, if given over to the treatment of lesions of this kind, would necessarily be devoted to the disheartening occupation of affording at best but temporary relief from tumors that were essentially inoperable.

Thus, neither pathologist nor surgeon, acting independently, could feel anything but discouragement when confronted by new-growths whose behaviour and microscopic appearance were so in accord with the tradition of high malignancy. However, as time went

on and cases were followed to their end, it became increasingly clear, from the unexpected longevity shown by patients with verified gliomas, that there must be a number of relatively benign varieties favourable for surgical removal provided operative methods could be evolved for their exposure and enucleation. To bring some possible order out of this chaos, during the past several years, as may be known, my co-workers and I have been engaged in the attempt to classify the gliomas in our collection on the basis of their life history and behaviour taken in conjunction with their histogenesis—a task in which Dr Bailey played a highly important contributory role.

Particular gliomas. Meanwhile, the gross appearance of these tumors as they are encountered at the operating table with the details of the preferential surgical treatment that has been in course of development, has received but little emphasis. It is high time that these wants, for the several now well recognized types of glioma, should be more fully met.

In an address a year ago before the Medical Society of Lund (2), a detailed account was given of our surgical experiences with what, from a therapeutic standpoint, are the most unpromising of all the gliomas—the medulloblastomas. These highly malignant tumors which are particularly common in childhood, which in the majority of instances take their origin from the roof plate of the fourth ventricle, and which tend to widespread transplantation through inoculation of the cerebro spinal spaces, prove, in the present state of our knowledge, to be therapeutically the most baffling of all gliomas. In whatsoever way they have been treated, whether by decompression alone or by radical extirpation combined with radiation, recurrence of symptoms from continuance and rapid spread of the growth has been inevitable, and though temporarily brilliant results have amply justified the labor spent upon them, the longest period of survival in any one case was five years. Embarrassing as it was to prepare and publish the report of the sixty-one examples of these tumors in which the operative mortality had been higher than for any other form of intracranial neoplasm, it seemed necessary to do so

for the purpose of focusing attention upon them. We now know, at least, what we are dealing with and that is more than could be said of these tumors ten years ago.

In the concluding paragraph of that address, I expressed the hope that some day the far more agreeable task might be undertaken of preparing a comparable survey of another group of glomatous tumors that show a comparable predilection for the same mid-cerebellar region of childhood but have a far more favourable prognosis. I propose to take advantage of the present opportunity to do so.

Cerebellar astrocytomas: early experiences. The tumors to which I refer belong to that nebulous group of lesions formerly spoken of as glomatous cysts which now prove to have a neoplastic basis composed of highly differentiated neuroglial cells known as astrocytes. Step by step, we have come to learn enough of their histogenesis and behaviour to know how they should properly be treated, but it has been a slow and painful process like feeling one's way in a fog. I see no better way of showing what obscurities once beset us than by describing my first experiences with the few cerebellar tumors operated upon between 1908 and 1912 which now prove to have been of this type. They begin the series of seventy-six examples (cf. Table) which my associate, Dr. Eisenhardt, and I have taken the trouble, for the purpose of this report, histologically to restudy and reverify.

As was inevitable, this temporary concentration upon tumors of a single type with the painstaking re-examination of all the tissues has proved to be highly informing. By giving us a much clearer mental picture of the histological architecture of the astrocytomas as a group than we previously were able to carry when from day to day and week to week we were examining gliomas of varied structure, behaviour and location, it has enabled us to correct a number of erroneous diagnoses that had crept into our previous lists. At the same time, and what is more important, it has forced us to conclude, as will be told, that the attempted separation, at least of the cerebellar astrocytomas, into two types, protoplasmic and fibrillary, may for all practical purposes be abandoned, for most of the tumors

prove to be composed of both elements and their natural history is the same whether the lesion is predominantly fibrillary or predominantly protoplasmic.

One outcome of this critical revision of the tissues has been the discovery among our recorded cerebellar astrocytomas of three cystic tumors with an unquestionable hæman glioblastic basis, two of which had been overlooked when these particular lesions were recently made the subject of a detailed report (3). These blood-vessel tumors, all or most of which in years gone by received a pathological diagnosis of "angiomatous" gliomas, are commonly, perhaps invariably, cerebellar lesions and have a life history closely resembling that of the cystic astrocytomas of the region. Partly for this reason, partly because we had not as yet found how positively to distinguish them from the gliomas, partly because they are apt to produce a reactive gliosis in the adjacent nervous tissues, these three examples came to be erroneously classified as fibrillary astrocytomas, and were never subsequently detected. As a matter of fact, the very case that would otherwise have served to lead off this present series now appears to us to have been so misjudged. The story follows.

It was that of a young man named Milton Ferguson, well known to a succession of my assistants who when eight years of age was first operated upon in March of 1907 at the Johns Hopkins Hospital at which time no cerebellar lesion was detected. At a second operation in June, 1908, a cerebellar cyst ("degenerated glioma") was found and evacuated. Seven years later at the Brigham Hospital in July, 1915, owing to recurrence of symptoms, the cyst was re-exposed and its wall thoroughly puckered by formalin fixation. A fourth operation (at other hands) was made in June, 1918, when a supposedly inoperable glioma was disclosed. A year later, in May, 1919, at a fifth operation, the cyst was found to be largely replaced by a tumor mass which was partly removed and diagnosed, interestingly enough, as "neuroglial granulation tissue." A sixth operation was called for six years later, in April, 1925, when a radical extirpation of the recurrent growth was undertaken and presumably because of a reactive gliosis it was mistaken for a fibrillary astrocytoma. The patient though nearly blind at the time of the first operation is still living well, and self supporting, now twenty three years later. This long survival period was entirely compatible with the behaviour of an astrocytoma but on further

study of the tissue this diagnosis appears to us to be open to such doubt that we feel obliged reluctantly to exclude the case from our revised list

It is proper openly to face this apparent blunder for the reason that this particular case has crept into the literature of the gliomas and has been alluded to (its original Johns Hopkins Hospital Surgical Number 20433 serves to identify it) on a number of occasions—from the standpoint of the cyst (4) from the standpoint of calcification in slowly growing gliomas (5), from the standpoint of cerebellar tumors in childhood (6), and as an example of a fibrillary astrocytoma (7). The admission of a probable diagnostic error in this case points its own lesson and at the same time gives the opportunity to call attention to the similarity in the life history of a cerebellar angioblastoma and astrocytoma to which there will be occasion to return in considering the differential diagnosis.

In 1907 when this Ferguson boy first came under observation, brain cysts containing yellow fluid were usually looked upon in accordance with the belief of Sir Victor Horsley as degenerated gliomas. That these xanthochromic cysts were invariably associated with a mural tumor was unknown or was unappreciated, and the fact that the cyst encountered at the second operation would be found eight years later to have become largely replaced by a solid growth was wholly unforeseen. Emphasis, in other words, was laid in those days on the cyst rather than on the tumor that gave origin to it, and because the accumulated fluid was presumably secreted by the cyst wall, it was something to be destroyed or removed if possible. This, therefore, was the customary procedure, as exemplified by the first two cases in the series as now revised.

CASE I. A physician's child under two years of age and supposedly rachitic had been under observation off and on during the year 1908 for a rapidly progressive hydrocephalus which had developed subsequent to a fall after an apparently normal first year of life. A series of combined ventricular and lumbar punctures led to the conclusion that there must be a mechanical block at the foramen of Magendie. The child gradually became bedridden, spastic subject to convulsive (cerebellar) seizures, and an exploratory operation was finally deemed necessary.

Accordingly under ether anesthesia on April 29, 1909 the exploration was made and a huge mural cerebellar cyst was disclosed. An attempt was made to dissect out the cyst wall (Fig. 1) but this had to be abandoned short of completion owing to the depth to which the cavity extended. The child did not long survive the operation, and at autopsy the deeper residual part of the cyst (Figs. 2 and 3) was found to be partly lined by a "gliomatous tumor which when restudied in 1923 was recognized as an astrocytoma and classified as protoplasmic. Though predominantly so it nevertheless contains many scattered fibrils.

In the next case, in the process of extirpating the cyst and nodular mural tumor was at the same time accidentally removed. This was looked upon at the time as a matter of secondary interest rather than of primary importance and the favorable outcome was long ascribed to the eradication of the secreting cyst wall.

CASE 2. *Permanent cure of a gliomatous cerebellar cyst following a single operation at which a mural tumor nodule was inadvertently removed in process of removing the cyst wall. Patient living and well after 21 years.*

April 1, 1909. Admission of Edward P., a carpenter 26 years of age referred by Dr. J. G. Hopkins of New York with the complaint chiefly of headaches and loss of vision.

Anamnesis. For four years and perhaps longer he had been having periodic headaches with blurring of vision and some slowly increasing unsteadiness in gait. He had been seen at the Johns Hopkins Dispensary in April, 1906 when a diagnosis of "nervous headaches" was made and he was fitted for glasses. In August, 1908 he began having periods of temporary amaurosis and his sight then failed rapidly. Eight weeks before admission an exploratory craniotomy with exposure of the left cerebral hemisphere with tapping and temporary drainage of the ventricle after disclosure of a hydrocephalus had been made in Brooklyn, New York.

Examination showed a young man with an advanced cerebellar syndrome and a small riding bone flap without decompression over the left side of the cranium. There was a choked disc of 7 diopters with secondary atrophy. Vision was reduced to light perception and the counting of fingers with occasional correctness. Some hypæsthesia of the right face and tinnitus in the right ear suggested a probable tumor of the right cerebellar recess.

Operation. April 24, 1909. Under ether the customary cerebellar exposure was made with bilateral flaps and removal of the posterior arch of the foramen magnum. A coincidental ventricular puncture was not yet a common practice and extra cranial bleeding was difficult to control. On opening the dura the cerebellum extruded greatly and

marked foraminal herniation of the tonsils was present. Palpation revealed a soft area to the left of the midline. A needle was inserted and yellow, quickly clotting xanthochromic fluid was withdrawn. The effort, customary at the time, was then made to dissect out the cyst by brushing it away from the adjacent cerebellum. In this process a solid nodule of tumor the size of the terminal segment of the thumb was unexpectedly encountered and removed with the deeper part of the cyst wall. A portion of the tumor nodule which was firm and "gritty" was submitted to Dr. F. B. Mallory and termed a "psammomatous glioma" probably malignant in view of existent mitoses.

Subsequent course. Following this operation the patient made a speedy recovery. His cerebellar symptoms rapidly subsided and though the choked discs were not quite flat at the time of his dismissal on May 11, they were fortunately receding with retention of light perception. The patient subsequently learned broom making at a school for the blind and this occupation has enabled him to marry and support his two children. He is now 47 years of age and writes that he works at his trade eight hours a day.

The fact that in the process of dissecting out this cyst a nodule of tumor was encountered and removed was regarded at the time as purely incidental. Indeed, when in 1923 Dr. Paul Martin (4) made an end result study of the various xanthochromic cysts of the nervous system, all of which at that time were supposedly glomatous, the relation of the tumor removal to the long survival period in this case was scarcely suspected.

When an experience such as this is now looked back upon, it seems that only stupidity could have so long delayed our better understanding of these lesions. Indeed, we did not hit upon the explanation of our many failures till fifteen years later, and then only because we began routinely to search for and to remove the mural tumors from all cysts largely to give us tissue for tumor classification. In partial extenuation, it must be recalled that the cases did not follow in sequence and between them many experiences of other kinds relating to other tumors intervened to obliterate their memory and obscure their significance. What is more, we of course could not foresee what had been accomplished for this patient and the immediate result was no better than would have been brought about by the less hazardous procedure of merely evacuating the cyst.



Fig. 1 (Case 1.) Photograph of portion of excised cyst wall spread over a ball of cotton to give its approximate size.

The third case in this early series was that of a child of six with an advanced cerebellar syndrome who was first operated upon in May, 1910, when a large xanthochromic cyst was merely tapped and evacuated. After a year's relief from symptoms a second operation by another surgeon disclosed a large glomatous tumor which was partly removed, and after another interval of two years an attempt at my own hands to make a more radical extirpation led to opening of the fourth ventricle with subsequent fatality from meningitis.

The fourth case, which first came under observation in October, 1910, six months later than the preceding one, is as follows:

A boy nine years of age, blind on admission, gave a history of unsteadiness for a period of at least five years. At operation a marked pressure cone was disclosed but no tumor, punctures of the hemispheres being negative. The decompression gave relief for over a year when headaches and vomiting returned and at a second operation in January, 1912, a large median cyst was encountered and its wall partly removed. Two years later he was brought to the Brigham Hospital bedridden and having a succession of critical Jacksonian seizures. The unmistakably advanced cerebellar syndrome was complicated by coexistent signs of spinal paralysis suggesting tumor implantation. A third operation was undertaken, January 16, 1914, when underlying a superficial



Fig 4 (Case 1) Coronal section of the brain (3 1/2 nat size) showing the marked hydrocephalus and the intact residual anterior portion of the cerebellar cyst (cf Fig 3) From the dorsal remnant of mural tumor indicated by the arrow a block has been cut out for histological verification [Ref p 132]

cyst a large firm median tumor projecting through the foramen magnum was uncovered. The attempted piece meal extirpation of the growth was abandoned owing to the patient's condition. Death from respiratory failure soon followed and at post mortem examination the remaining portion of the growth was found capped by a concealed cyst (Fig 4). There was a coincidental extensive syringomyelia of the cord accounting for the spinal paralysis.

The tumor, recognized as a glioma, was carefully described at the time by W. T. Councilman. It was restudied by Bailey in 1923 who regarded it as an astrocytoma of protoplasmic type and it is so classified in our monograph (3) though it contains many sparsely disposed fibrils.

The next case, the fifth in this original series, owing to the unusual premonitory history and prolonged interval of comparative relief following mere cyst evacuation merits reporting in some greater detail.

CASE 5 *Emergency puncture of cerebellar cyst following sudden respiratory failure. Removal of large mural nodule at operation 13 years later. Patient now symptom free 32 years from probable onset of symptoms.*

October 22, 1911. Admission to the Johns Hopkins Hospital of Ora M., 17 years of age, referred by Dr. Charles I. Kahlke of Chicago.

Emergency operation. The patient on reaching the hospital late in the evening was found to be in a critical condition, complaining of intense headache, highly restless, with a choked disc advanced to the stage of secondary atrophy. The anamnesis sketchily secured from his attendant strongly suggested a cerebellar tumor, and recognizing the urgency of the case it was being worked up as rapidly as possible. That a critical condition of this sort could be tided over by the intravenous administration of hypertonic salt solution was then unknown.

On the afternoon of October 23, while the preliminary neurological examination was being checked in the ward, the patient became cyanosed, developed Cheyne Stokes respiration, had an agonal, copious

movement of the bowels and stopped breathing. Artificial respiration was immediately and successfully instituted. Acting on the inspiration that he might conceivably have a cerebellar cyst, he was transported by stretcher to the unfortunately distant operating room which was hurriedly prepared. There, face down on the cerebellar table in a position favourable for artificial respiration by Schafer's methods, after scant aseptic preparation a burr opening was made over the right cerebellar hemisphere and a needle introduced through the dura. A large xanthochromic cyst was struck, fluid spurting from the needle, spontaneous breathing was almost immediately resumed and an hour later the patient was responding to questions. The period of respiratory cessation had been almost precisely three quarters of an hour.

Anamnesis. This, as subsequently elicited in detail, served unquestionably to date the onset of symptoms from the spring of 1897 when at the age of four, after recovery from a prolonged attack of whooping cough, the boy was noticeably unsteady on his feet and during the remainder of the year had early morning attacks of occipital headache and vomiting. Associated with some of the more severe bouts of vomiting spasms occurred in which he would stiffen out. The attacks, which were regarded and treated as choreiform, recurred periodically during 1898 and 1899 alternating with intervals of a few months' duration in which there was symptomatic relief.

In the spring of 1900 the boy's head was observed to become unduly large, and there followed a period of five years during which, apart from some residual awkwardness of locomotion, he remained symptom-free. In 1906, however, headache and vomiting again appeared in much exaggerated form with marked ataxia and definite impairment of vision. Constipation, meanwhile, had become a most troublesome symptom, for the boy dreaded to evacuate his bowels as straining greatly increased his discomforts.

Following an operation of some sort at this time, the details of which remain unknown, there was again a period of relief so that for another five years in spite of occasional headaches, vomiting and persistent instability, he was fairly regular in his attendance at school. Two months before his hospital admission with some abruptness the symptoms had again suddenly become greatly increased with intense suboccipital headaches and such a degree of inco-ordination he was necessarily confined to bed.

Interval history. Following the emergency operation recounted above, there was a smooth convalescence marred only by prolonged hiccuping. The cerebellar ataxia which at first was excessive

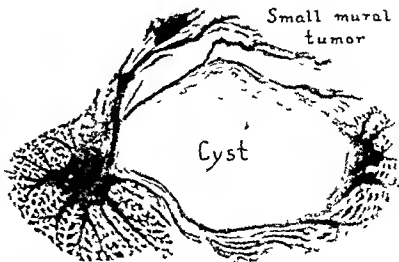


Fig 3 (Case 1) Photograph (nat size) of a section through the entire cerebellum showing the situation and extent of the flat mural tumor variously diagnosed as degenerated glioma or congenital cyst (1909) and as protoplasmic astrocytoma (1923). It shows abundant fine fibrils. [Rel p 132.]

soon subsided and at the time of his discharge on November 7 he was walking with support and in a fair way toward recovery from all symptoms apart from some impairment of vision.

He subsequently resumed his high school studies, caught up with his former class and graduated two years later. He then attended a teachers' institute and a letter of August, 1915, stated that he was teaching in a country school and that the summer before he had without the slightest fatigue climbed Pike's Peak one night to see the sun rise. His only handicap was some persistent ataxia of his right hand. A year later he went into business for himself as an apothecary.

In May, 1918, during the writer's absence in France, there was a temporary return of symptoms. He consulted a neuro surgeon who on the basis of a right astereognosis advocated a cerebral exploration which the patient refused and the symptom spontaneously subsided. [Astereognosis in the right arm had been a feature of the case throughout. Its occurrence in association with cerebellar cysts has been covered in another connection (3).] Another attack more serious in nature occurred in December of 1922 at which time Dr. Kahke re-evacuated the cyst. In September, 1924, owing to a return of pressure symptoms with increasing inco-ordination he again consulted Dr. Kahke who after an ineffectual attempt again to tap the cyst referred him to the Brigham Hospital.

Admission. October 10, 1924. The patient at this time was suffering from severe occipital headaches, vertigo, hiccuping and constipation. Examination showed a markedly staggering gait, nystagmus, ataxia, hypotonicity, right astereognosis, exaggerated deep reflexes, and choked discs.



Fig. 4. (Case 4) Mesial section of brain showing partially excavated astrocytoma capped by concealed cyst the detection and evacuation of which might even in 1914 have made complete extirpation of growth possible and have forestalled fatality [Ref. p. 134]

Re operation On October 23 under ether anesthesia a proper bilateral exposure of the cerebellum was made for the first time. A huge, multilocular cyst holding *circa* 125 cubic centimeters of yellow clotting fluid was evacuated, a centrally placed mural nodule of hen's egg size (Fig. 5) was exposed and extirpated apparently in its totality. The tumor proved to be an astrocytoma of fibrillary type.

Postoperative course Convalescence was somewhat stormy. There was fever and a succession of punctures were necessary to remove bloody cerebrospinal fluid. This was overcome and the patient was discharged on November 15 with all symptoms greatly improved. His letters during the subsequent six years repeat the statement that he had never known before what it was to feel really well and he continues to conduct his business as an apothecary.

The notable feature of this story is the long antecedent history before the tumor reached the point of causing what might have been a fatality from medullary compression. Fourteen months rather than as many years would have been an over long premonitory period

for a medulloblastoma in the same situation. But of such matters we then knew nothing any more than we knew that the mere evacuation of the cyst would only serve to postpone the day when a radical attack on the underlying tumor would be necessary, a task much more easily accomplished at a primary session when the mural tumor, as it was in Case 3, might happen to be comparatively small. Unfortunately, however, the surgical problem is not always so simple as this proposal would imply, as is shown by the last of the six cases in this early series.

CASE 6 Ten years before entrance when 13 years of age, the patient had been thrown from a mule striking the back of his head. He was knocked unconscious. Two years later, owing to posterior headaches and vomiting he was in a hospital for the better part of a year. Since that time, though never wholly free from symptoms he had managed to finish school and take up the trade of carpentry. Vision had been slowly failing and of late there had been

periods of temporary blindness. During the three weeks before admission he had been having a series of "spells" characterized by cyanosis and rigidity but without unconsciousness. Constipation had been a most troublesome symptom for many years.

Examination showed a bedfast and stuporous young man with a pulse of 60, complaining of intense headache. There was a bilateral advanced choked disc of 6 diopters with vision reduced to counting fingers, a bilateral abducens palsy, and nystagmus. Gait, station and inco-ordination were impossible to test. Neither deep nor superficial reflexes could be elicited.

A cerebellar tumor with secondary hydrocephalus was suspected but the patient's general condition was too critical to justify the prolonged inhalation narcosis necessarily employed in those days for a cerebellar exploration. It was thought diagnostic information might be gained and that benefit might follow a callosal puncture, a procedure which at the time was warmly advocated in some quarters. The puncture accordingly was made on April 29 with only temporary amelioration of the symptoms. Headache and vomiting in aggravated form soon returned, swallowing became impossible necessitating nasal feeding, and death with hyperthermia (108°F) occurred on the eighth day.

The autopsy showed a hydrocephalic brain with a large, centrally placed multicystic cerebellar "ghoma," inseparably incorporated with the brain stem (cf. Fig 6).

The postmortem findings in this long neglected case would have been enough to discourage the most optimistic from undertaking an operation for any such tumor. That the surgical problem was in any way related to the preceding experiences, other than that the growth was one of the kaleidoscope manifestations of gliomatous tumors in general, was not suspected. Yet could this growth have been attacked, as today, under local anesthesia and its chief mass electrically removed with relief of the hydrocephalus and re establishment of cerebrospinal fluid circulation, the patient might well enough still be alive.

Stages of classification. Taken by themselves and properly interpreted, the experience with these six cases from this original Baltimore series would tell almost all there is to be told about these cerebellar astrocytomas. They make it sufficiently clear that symptomatic indications of the disorder can be traced to childhood, that the lesions at the outset tend to be cystic, that symptomatic recurrence may be expected after mere cyst evacuation, that the cysts contain a mural tumor which

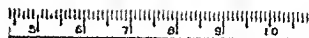
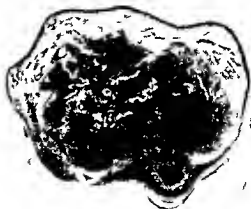


Fig 5 (Case 5) Photograph of wet tissue nodule (nat size) as removed at secondary operation

may be expected to increase in size ultimately to fill and largely replace the cavity, that removal of the mural tumor nodule may result in cure which indicates that the xanthochromic fluid exudes from the surface of the tumor and not from the wall of the cyst proper.

But these interpretations are purely retrospective. The long survival periods of the favourable cases were wholly unforeseen and fifteen years were to elapse before we came to correlate the type of the ghoma with its clinical prognosis. In our groping efforts, meanwhile, to find some convenient method of distinguishing between surgically favourable and unfavourable gliomas, we came to separate them into (1) *gliomatous cysts*, when at operation the bulk of the space-occupying lesion was found to be cystic, (2) *cystic gliomas*, when a cyst-containing tumor was encountered, and (3) *non cystic gliomas*, which supposedly were the least favourable of all as they showed no tendency to undergo what was thought to be cystic "degeneration."

We were in this primitive stage of glioma classification when in 1922 at my suggestion Dr. Martin made an end-result study of the tumors of the first category—the "gliomatous cysts." At that time the relation of the tumor nodule and its removal or otherwise to the survival period was scarcely suspected for though Case 2 cited was then living after



Fig 6 (Case 6) Mid section of brain showing multicystic astrocytoma at terminal stage after ten years of symptoms unaffected by previous operations. Squared area represents site of block removed (1925) for special stains showing incorporation of tumor with brain stem without sharp demarcation [Ref p 137]

14 years, a tumor nodule having been removed with the cyst wall, Case 5 was also living after 11 years following a mere cyst evacuation.

All this was highly confusing and even though Dr Martin's report (4) served to show that the average survival period of patients with "gliomatous cysts" was surprisingly long, a similar study two years later by Dr van Dessel (5) of a group chiefly of non-cystic gliomas, which were undergoing sufficient calcification to betray their presence in X-ray films, had a correspondingly favourable prognosis. Highly dissatisfied therefore with our crude glioma classification and deprecating the fact that the "gliomatous cysts" based on xanthochromic fluid alone had come to be incorporated in our verified tumor series [we then little suspected that some of them had an angiomatous rather than gliomatous basis],

Dr Bailey undertook the task to which I have already alluded of attempting histologically to classify the 400 or more gliomas in the collection into more or less distinct groups. Our programme was to follow two independent lines which were to converge, on the one hand the tedious microscopic re-examination by special stains of the tissues in the tumor collection, and on the other, the more mechanical but equally time-consuming task of overhauling and tabulating the clinical data and of pursuing patients and their family doctors for final results.

That such a schema of classification as was finally published three years later would serve merely as a useful working basis to be simplified and amended in the light of further experience was fully appreciated. In the course of this primary general survey it was found that

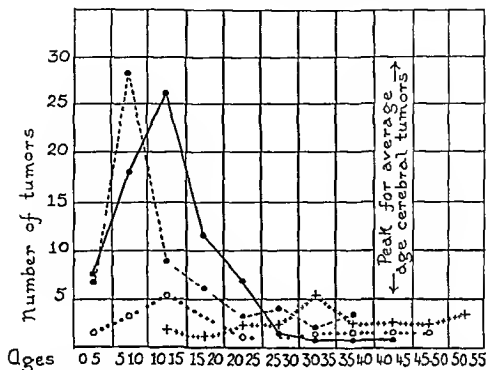


Fig 7. Graph showing age incidence in hemi decades of patients with four principal types of verified midcerebellar tumors: 76 astrocytomas (solid line), 62 medulloblastomas (broken line), 22 hemangioblastomas (crossed line), 19 ependymomas (circled line) [Ref p 145]

several cystic tumors with an angioblastic basis had come to be incorporated among the gliomas, and a subsequent detailed study of these particular lesions (3) disclosed the fact that they are almost invariably situated in the cerebellum. This naturally suggested that a detailed study of the several histologically-differing types of glioma might show that they too had definite seats of predilection. What is more, it is only in the course of such a particularized study of tumors of one type and position that their peculiar symptomatology begins clearly to stand out. Conversely, any inconsistency in behaviour and symptomatology of a histologically-classified tumor picked up in a systematic review of a group of cases immediately suggests that some error in the pathological diagnosis has inadvertently crept in and indicates that the case deserves thorough revision.

2. TABULATION OF CASES¹

The tedious process of getting the main facts of a long series of cases in chronologically tabular order is essential to a study of the

present sort. It not only serves to show when and how progress has been made but it brings to light the more notable deviations from what proves, on the basis of averages, to represent the common type.

A tabulation of the more definitely fibrillary astrocytomas which had been identified in the tumor series up to January 1, 1924, was published by Dr. Bailey and myself in our monograph on the gliomas (7). We, however, were at that time chiefly concerned with the histopathology of the lesions irrespective of their situation and had only begun to have glimmerings of the predilection of certain gliomas for certain sites. Of the 32 cases then identified, nine were cerebral, and the fact that these nine cerebral lesions occurred in patients with an average age on admission of 33 years whereas in the cerebellar cases the average age was only 13 years certainly required explanation.

Another peculiarity that needed looking into was the fact that among the remaining 23 patients with cerebellar lesions there were several in whom the symptomatic onset was at a surprisingly advanced age. A critical

¹To be found appended

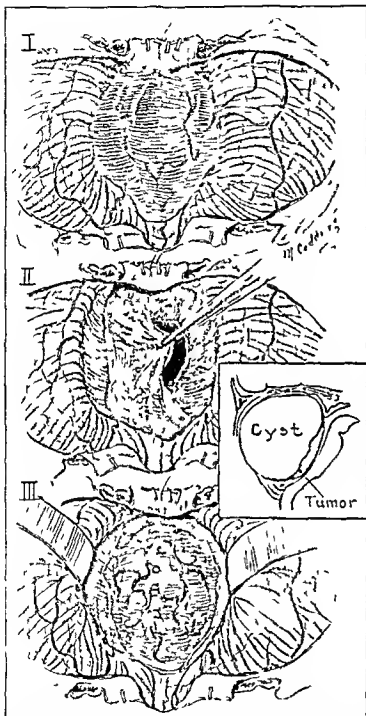


Fig 8 (Case 61) Essentially cystic fully exposed median astrocytoma with flat mural nodule on the roof of the ventricle in an infant I primary view of lesion beneath arachnoid membrane II withdrawal of cyst wall III cavity showing residual mural tumor in depth Insert, estimated mid section of lesion [Refs pp 151 and 160]

re examination of these exceptional cases discloses two unmistakable angioloblastomas which had escaped us, a probable arachnoidal cyst with mural gliosis rather than tumor, and a tumor of which the diagnosis is highly questionable. A few other cases we have felt obliged to exclude because of the uncertainty of the location of the lesion, whether pontine or cerebellar, or because we were for other reasons in doubt. This leaves from our original 1908-1923 list of 32 only 19 examples of unquestioned cerebellar astrocytomas of fibrillary type.

Meanwhile, however, to this greatly reduced list of cases antecedent to January 1, 1924, nineteen additional ones can be added, making 38 in all, many of them being examples of "glomatous cysts" which have since been histologically verified through secondary operations. What is more, for reasons to be more fully explained in the section on cytology, the cerebellar astrocytomas previously classified as protoplasmic have been incorporated in the Table because from a prognostic and practical point of view the attempt to distinguish between protoplasmic and fibrillary types among these cerebellar astrocytomas of childhood is needlessly artificial. It is most rare to find a fibrillary astrocytoma of the cerebellum without some area in which the cells are of protoplasmic type; rare also to find a tumor that is so predominantly protoplasmic as greatly to prolong a search for fibrils.

We consequently have come to feel that the tumors normally have a combined cytology, and their clinical behaviour and prognosis prove to be the same whether the cells of one or of the other type predominate. Accordingly, all astrocytomas of the cerebellum have

properly come to be allocated together. Thus as our knowledge of the behaviour and favoured situation of these different types of glioma increases and becomes more exact, the cases gradually tumble into their proper and possibly final categories.

In this fashion, a tabular survey by pointing out similarities as well as by pointing out the more striking type-deviations, serves to indicate where the attention of those studying the subject should be focused. In addition to this, the existing table as it stands is informing and useful in showing how the therapeutic procedures have, step by step, been modified to meet newly acquired information—when ventricular punctures began to be employed in course of operation, when cerebellar cysts were merely evacuated, when attempts were made to destroy the cyst walls by excision or fixation, when the importance of the mural nodule began to be appreciated, when tumor classification began to show its effects, when radiation was given a therapeutic trial, when the central position of the lesion began to be taken into account with vermis transection as the preferential method of its exposure, when electro-surgery first began to be employed. All these are matters which will be touched upon in their proper sequence.

3 GENESIS

In the recent critical review of the medulloblastomas (2) stress was laid on the fact that the majority of these tumors were median in position, occurred in early childhood and appeared to take their origin from the roof of the fourth ventricle, a vertical incision of the vermis being the favoured method of exposing them. This applied to 52 of the 61 cerebellar cases (85 per cent), there having been seven examples (15 per cent) which were exceptional in that the patients were older and the tumor was laterally placed in one of the hemispheres. The probable congenital origin of these tumors was assumed on the basis of their peculiar cytology, situation, occurrence in early life, and recorded presence in twins.

Among other tumors that show a predilection for this structurally complicated region constituting the roof plate of the fourth



Fig 9 (Case 61) Infant 22 months of age 17 days after operation to show hydrocephalic head, well healed wound and absence of protrusion [Ref p 151]

ventricle, the angioblastomas are unmistakably ascribable to a congenital fault of development and indeed, as Lindau's studies (8) have shown, possess definite hereditary tendencies. The same, I think, holds true of the ependymomas of this region.¹ Whether the tumors under consideration can with comparable probability be ascribed to some developmental fault in the region is less clear. The angioblastomas of the brain are, without exception it is safe to say, found only in the cerebellum, the medulloblastomas in our series, with two possible exceptions, are likewise confined to the cerebellum, the ependymomas, though more commonly cerebellar, begin to show a tendency to occur elsewhere, there having been eighteen associated with the fourth ventricle and seven with the cerebral ventricles, and finally the more numerous astrocytomas appear to be about equally divided between median cerebellar and scattered cerebral lesions.

¹ These distinctive lesions were among the first of the gliomas to be easily differentiated. Reports from this clinic of six examples four of them of the fourth ventricle have been made by P. Bailey (9).

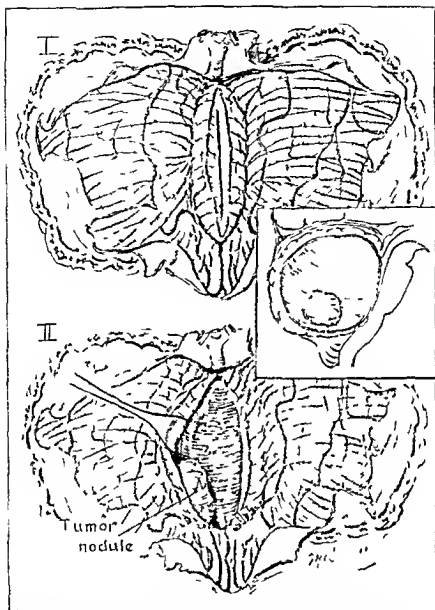


Fig. 10 (Case 57) Showing I prominent vermis with primary incision II, centrally disposed cyst with small, laterally placed mural nodule [Ref p 156]

4. INCIDENCE

1. Percentage To September 10, 1930, the brain tumor series contained 805 gliomas of all kinds. For a variety of reasons the precise type of 204 of these tumors remains in doubt but the remaining 601 with a reasonable degree of accuracy have been definitely classified. Among them are 227 astrocytomas of which the 76 cases the subject of this

report arise in the mid cerebellar region. These represent therefore approximately 9.4 per cent of all the gliomas and about one third of the astrocytomas of all types and all situations.

As already intimated and for reasons to be gone into later on, our interpretation of these cerebellar astrocytomas is changing in that we no longer feel disposed to distinguish be-

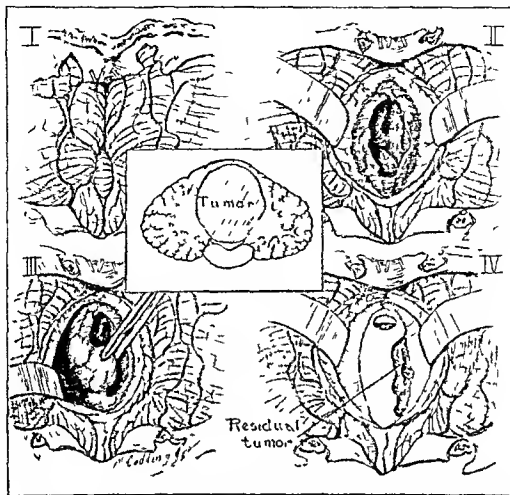


Fig 11 (Case 69) Sketches showing I, the slightly prominent uvula and moderate tonsillar herniation, II, the deeply seated tumor partly exposed III, the tumor being dislodged after primary excavation, IV, the residual edge of adherent growth and widely opened ventricle. Insert shows presumed site of the lesion. [Ref p 158]

tween fibrillary and protoplasmic types, so far at least as the cerebellar lesions go. Whether further study will show, as we suspect it may, that the fairly numerous so-called protoplasmic astrocytomas of the cerebrium,¹ in view of their invasive tendencies and proneness to rapid recurrence, are tumors of less highly differentiated cells than astrocytes, remains to be seen. Whereas the benign astrocytomas of the type with which we are dealing and which tend to form cysts in their early stage of development seemingly occur in the cerebellum and cerebrum in approximately equal number, the invasive types of "protoplasmic astrocytoma" are not found

¹The cerebral astrocytomas 151 in number are at present subdivided into 64 of fibrillary type and 87 of protoplasmic type. Many of the latter are rapidly growing infiltrative tumors with abundant mitoses and should in all probability be separately classified. They moreover occur in patients with the average age of 40 years whereas the 17 cerebellar astrocytomas formerly classified as protoplasmic had an average age of 13 years.

in the cerebellum at all. They are confined to the cerebral hemispheres, occur almost without exception in adults, and have a prognosis almost as grave as that of the glioblastomas.

2 Age. A casual survey of the column in the table giving the patient's age on admission will show that the great majority were still preadolescent, the average age being 13 years. The average recorded duration of symptoms would lower the age of symptomatic onset to 11 years, which approximates the age on admission of the patients with medulloblastomas. Even this fails in all probability to give the correct impression, for the astrocytomas are most insidious in symptomatic onset, loss of vision from secondary optic atrophy being not infrequently the first recorded symptom. The accidental disclosure of the lesion in Cases 2 and 61, both of them

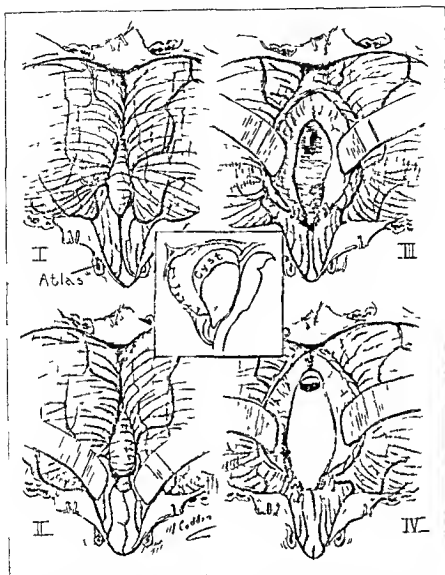


Fig 12 (Case 64) Showing I a slightly more prominent uvula than in Figure 11, with more marked tonsillar herniation necessitating laminectomy of atlas II the small nubbin of tumor exposed at the calamus III the deep seated lesion with small overlying cyst after vermian transection, IV the final wide exposure of dilated ventricle and aqueduct [Ref p 158]

children only 22 months old, was doubtless due to the unusual size attained by the cyst. Otherwise the symptoms might have been delayed for years.

These age calculations necessarily are made from what the clinical histories record and doubtless a more searching anamnesis when the older histories were elicited would have brought out antecedent symptoms that were

then looked upon as irrelevant, such, for example, as mitutinal vomiting ascribed to some gastric derangement of childhood and long forgotten. However this may be, not a few of the clinical histories of patients whose age on admission exceeded the average, clearly indicate a long drawn out preliminary story. Of this Case 5 provides a striking example, the patient, aged 17, having had

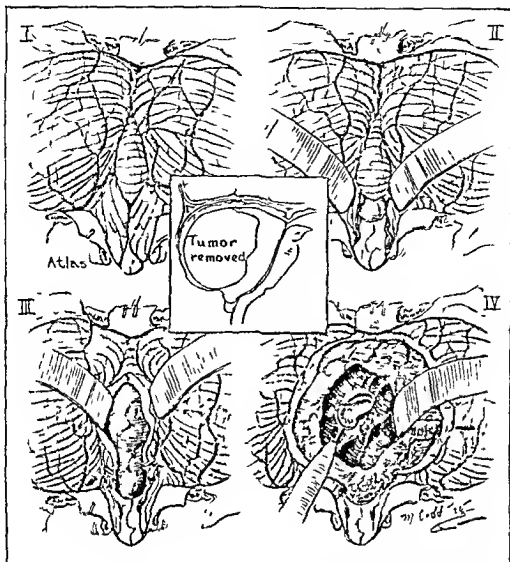


Fig 13 (Case 70) Showing I, the slightly prominent vermis and tonsillar herniation necessitating laminectomy of atlas, II, the visible tumor shown by separating tonsils, III, median incision of vermis with clips on chief entering vessels, IV, the process of excavating tumor by scalloping. Insert shows estimated degree of extirpation giving temporary relief of symptoms [Ref p 159]

periodic attacks of suboccipital headache and vomiting for a period of thirteen years. Among other examples is that of a 21-year-old woman (Case 33) who had suffered from headaches and vomiting pretty much all her life and on whom a subtemporal decompression for unlocalizable tumor had been made five years before admission. Still another is that of a 16-year-old girl (Case 60) who for several years before she became conscious herself of any disability had been "teased" by her playmates because of her unsteady gait.

In the accompanying chart (Fig 7) the ages of the 76 cases on admission are recorded in

hemidecades together with the 62 verified medulloblastomas. The 22 angioblastomas and the 18 cerebellar ependymomas. The fact that the curves of the two larger groups do not more nearly correspond merely goes to show that the symptomatic effects of the astrocytomas become a source of anxiety less early in life. To put it in another way, the position of the peak of the curve may be taken as a measure of the awareness of practitioners, more particularly of pediatricians, ophthalmologists, and neurologists, in regard to the early symptomatology of these tumors. We may expect the peak slowly but certainly to move to the left in years to come.

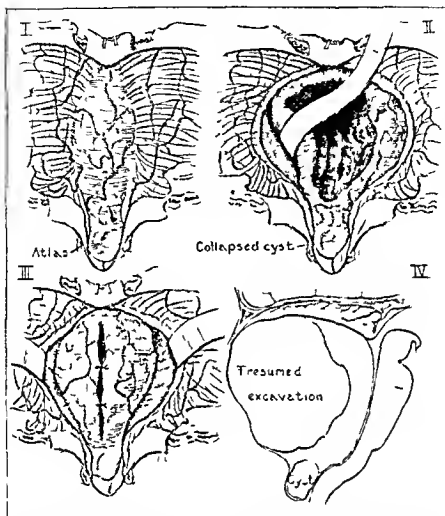


Fig 14 (Case 68) Showing I a solid median exposed tumor with cystic projection through foramen magnum II, excavation in process with tilting inward of shell III suturing of tumor shell to diminish size of growth IV, estimated mesial section (cf Fig 15) [Refs pp 155 and 159]

3 *Sex* Whereas the medulloblastomas proved to be three times more common in males than females, the astrocytomas are almost equally divided between the sexes and there is no apparent reason why tumors of childhood should show any selectivity on this score

4 *Trauma* The time worn question as to the possible relation of injury to tumors of any kind continues to repeat itself. Whether or not these tumors of childhood can be properly ascribed to some underlying fault of development, we cannot escape from the fact that a history of presymptomatic trauma

is recorded in a surprisingly large proportion of the cases, particularly should one include under this heading the bruising effects on intracranial structures of paroxysms of coughing

In consideration of the fact that pertussis is a common episode of childhood and that children are prone to fall and bump their heads, it may be assumed that these accidents to which the malady is so often ascribed by parents have merely served either to activate a latent growth or to call attention to symptoms previously unobserved. "Unsteadiness first observed during convalescence from



Fig 15 (Case 68) Brain on midsection showing larger residual tumor than expected (cf Fig 14, iv) Note small superficial cyst projecting through incisura, the degree of hydrocephalus and the forward displacement of the entire brain stem Patient had essentially no symptoms till two months before admission [Refs pp 154 and 160]

whooping cough", "suboccipital headache and vomiting after a fall from a swing", "a fall on the ice when skating with prompt occurrence of noticeable instability"—remarks such as these punctuate the anamneses of the records

5 SYMPTOMATOLOGY

In describing the cerebellar medulloblastomas (2), it was pointed out that the chronology of symptoms does not vary greatly from case to case and this is no less true of the astrocytomas. Indeed, the chief and one may say only clinical difference between the two lies in the relentless progress of the former and the more slow and often interrupted symptomatic advance in the case of the astro-

cytomas, which has its tragic side in that impairment of sight is often the first thing to call attention to the fact that something is seriously wrong with the child. Could one make a composite of the histories of all the cases thereby eliminating their more exceptional features, a story somewhat as follows would emerge

A child apparently normal in all respects begins toward the end of the first decade, possibly after a fall or an attack of whooping cough, to have early morning headaches with vomiting. Nothing much is made of this by the family doctor, should he be called in, for the child subsequently feels perfectly well, has had breakfast and wants to go out and play. This daily performance may continue for a considerable time, the child even going to school meanwhile. There may then be a remission of weeks

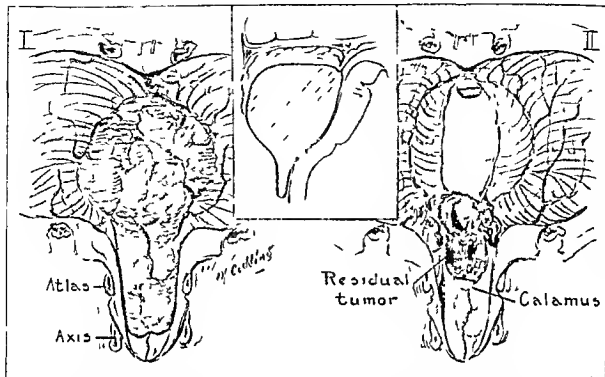


Fig. 16 (Case 53) Showing I, median astrocytoma which has come to the surface with a spinal tongue necessitating laminectomy of both atlas and axis for its exposure II the residual part of the tumor after incomplete extirpation [Refs pp 160 and 180]

or perhaps months and the episode be forgotten. On their re occurrence the symptoms are likely to be more pronounced and are apt to be ascribed to some gastro intestinal disturbance. This appears the more probable since the child finds that straining at stool brings on a headache and there is a tendency to become constipated. What is more, a mild daily laxative usually serves completely to mask the symptoms.

This sort of thing continues off and on until it becomes evident that the child is a little clumsy at play and gets knocked over easily. Very possibly, ere this the periodic headache and vomiting will have ceased completely or at least have occurred at much longer intervals, and if parents are observant they may notice that the child's head in the interim has increased in size more rapidly than it should. This however is usually discounted for the child meanwhile has become free from complaints and in all respects appears alert and well.

Matters may run on in this way for an indefinite time possibly with some increase in clumsiness of movement or in some instances with no noticeable change whatever until it suddenly becomes apparent, perhaps at school that the child's sight is poor. To counteract this glasses are usually prescribed but even should an ophthalmoscope be resorted to a child's retina is less easily examined than that of an

adult and because of the decompressive effects of the enlarging head, the optic papillæ often show no measurable swelling and the fact of their being pale and with margins blurred may easily pass unrecognized.

Due to the insidious nature of the symptomatic onset it is in this pre amaurotic stage of the process that even today the victims of these mid cerebellar astrocytomas as the Table will show, unfortunately continue to be admitted to hospital.

The headaches of which the patients complain are often frontal rather than suboccipital in location and in a few instances the frontal sinus had been explored under the belief that there must be a concealed infection. Indeed, by the time the headaches come to be localized in the suboccipital region the patient no longer refers to them as such but rather as local discomfort or a painful stiffness in the neck which is aggravated by any sort of effort likely to produce intracranial venous congestion.

Unquestionably the symptoms of these cases, even the headaches and vomiting hinge more upon the variability of tension of

the secondary hydrocephalus than upon the purely local factors. That some slight degree of hydrocephalus must be an early sequel even of a small tumor that overlies the fourth ventricle is easily understood. No less well known is the fact that in children the skull quickly and readily expands by separation of the sutures, *pari passu* with the formation of an obstructive hydrocephalus. But that a large, mesially placed and slowly growing tumor of the fourth ventricle may elicit no localizing symptoms whatsoever, should the pressure effects of the hydrocephalus be eliminated, is less well appreciated. And since this has considerable bearing upon the periods of relative symptomatic freedom which the histories of these patients bring out, it is worthy of the special emphasis which the following illustrative history will carry.

CASE 52. This boy, who was twelve years old when admitted on September 27, 1927, had a history of having been dropped when one year of age, severely bumping his head. Head aches described as bitemporal were subsequently of periodical occurrence and in time they came to be replaced by occipital discomforts not termed headaches which have continued to the present time. Six months before admission there had been attacks of projectile vomiting with complaint of stiffness of the neck. Instability of gait had been observed for two or three months. There had been some subjective haziness of sight for one week, and two days before entrance there had been a typical cerebellar convulsion. The child had been in more or less regular attendance at school, until six weeks previously.

The examination showed choked discs of 3 D with normal visual acuity in spite of some new tissue formation. Though nystagmus was absent there was unmistakable ataxia with dysmetria and hypotonia in all extremities, more pronouncedly on the right side. There was a positive bilateral Babinski with ankle clonus.

The diagnosis of a median cerebellar tumor was made, and the case was scheduled for early operation. In view of the threat to vision be meanwhile was given magnesium sulphate in amounts sufficient to provoke free catharsis. Under this treatment, as so often happens, his symptoms such as they were faded away, which accounts for the following statement which precedes my dictated description of the operation. "I do not recall when I have undertaken a cerebellar operation with less assurance of disclosing a lesion than in this boy's case. When ex-

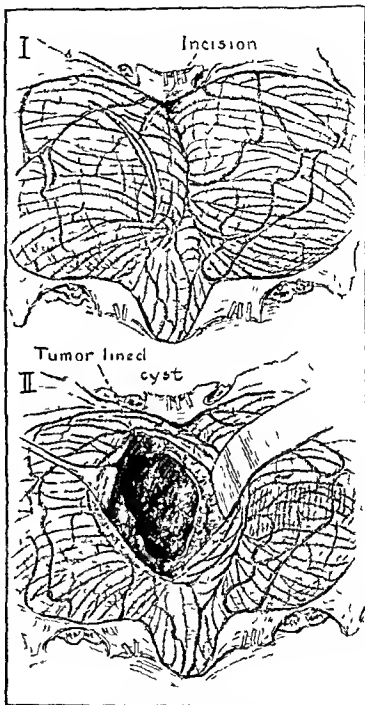


Fig 17 (Case 44) Showing I, the asymmetrical posterior surface of the cerebellum with almost wholly concealed vermis, II, primary incision through bulging hemisphere entering a large tumor lined cyst [Ref p 161]

amined yesterday afternoon, I positively could find no symptoms worth recording apart from his choked discs and the unmistakable hydrocephalic pressure changes in the skull. He certainly had no demonstrable cerebellar symptoms that would ordinarily have been accepted as such. The localizing diagnosis lay solely on the anamnesis and on the neurological tests on admission. In view of this it was the more astonishing that so large a median tumor was found."



Fig 18 (Case 44) Posterior aspect of the cerebellum (3½ nat size) to show the extent of pressure cone. Death due to postoperative formation of a clot in the partly excavated cavity of the tumor. [Ref. p. 161.]

A capacious median cyst was disclosed within which was an astrocytoma estimated to be the size of a hen's egg that directly overlay the roof of the distended fourth ventricle which was wholly exposed after extirpation of the growth.

Naturally enough the earlier in life the symptoms put in an appearance, the more rapid and evident will be the enlargement of the head. In the two youngest patients in the series not yet two years of age, there was little to show but hydrocephalus and a low grade of choked disc such as might accompany a mild cerebellar lesion of any type—or indeed characterize an acquired hydrocephalus from some cause other than tumor. Both of these infants proved to have exceptionally large cysts with a flat mural tumor. In the

first of them already described (Case 1), the cranial expansion was the sole premonitory symptom which had come on after an apparently normal early development.

The history of the second, a more recent case, in which the only premonitory symptom was instability, is as follows:

CASE 61. The child, 22 months of age, was admitted on December 31, 1928 with the sole complaint of having lost the ability to walk. A full term baby born February, 1927, breast fed, normal dentition, crawled at 7 months, took steps at 9, very active on feet at 12—a normal infant so far with perfect health. When 16 months old in June 1928 there was a single attack of morning vomiting which was never repeated. A month later he began to walk unsteadily and this gradually increased. By September he would often fall and latterly he had

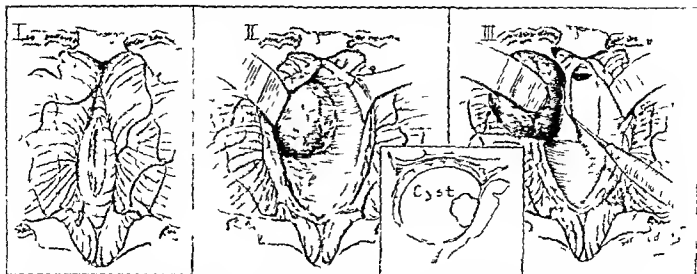


Fig 19. (Case 55) Showing I, moderately prominent vermian vertically incised to wall of cyst II, exposure of mural nodule, III, method of extirpation with partial excision of roof of ventricle [Ref p 161]

required support when walking. Otherwise there were no complaints and no observed symptoms. There had never been any headache.

Examination showed a normal appearing, alert, smiling and responsive child, contentedly occupied with his pictures and toys. The head was unduly large, but the parents insisted that it was no larger than was his elder sister's at the same age. The cranial roentgenograms nevertheless showed a thin vault, a slightly expanded sella, and separation of the coronal sutures indicating hydrocephalus. The eyegrounds were difficult to examine but they showed what was taken to be an early papilloedema. There was typical inco-ordination of cerebellar type with some hypotonicity involving the lower extremities and a wide stepping unstable gait. The upper extremities were apparently wholly free from ataxia. There was no nystagmus. The temperature (rectal) was irregular ranging from 97° to 101° . The clinical diagnosis of a median cerebellar tumor was made, a medulloblastoma or tuberculoma being favoured.

At operation on January 8, 1929, the dura with shreds of arachnoid was found to be somewhat adherent to a bulging central, dark, thin walled cyst of amazing dimensions occupying fully a third of the exposed field (Fig. 8). The cyst was found to contain canary-coloured fluid, the amount estimated at 80 cubic centimeters. Its wall was tough enough to be grasped and brushed away from the lateral hemispheres but in the depth of the cavity, about as shown in the sub sketch, a flat layer of mural glioma was seen to overlie the ventricle. Though a start was made toward the removal of this mass, the systolic blood pressure had fallen off to 60 so that after taking sufficient tissue for histological purposes without actually getting into the ventricle, the operation was concluded. The tissue on microscopic examination was found to be a typical fibrillary astrocytoma.

Convalescence was uninterrupted, and when discharged on January 28 the child (Fig. 9) was already walking with much less instability. He soon became symptom free and when last examined in June 1930, still remained so.

Experience indicates that a secondary operation will be called for at some future date in this youngster's case, but meanwhile he to all appearances is a normal, active child. What we must look forward to in all certainty in consequence of having abandoned the operation short of removing the mural tumor, is illustrated by the history which follows. The case, however, was not primarily chosen for this purpose but for the reason, more appropriate to this section, that disturbances of sight represented the inaugural symptom.

CASE 28. A healthy appearing boy, 16 years of age, was referred to the clinic November 3, 1921, because of "eye trouble." A year previously he had fallen from a horizontal bar in a gymnasium striking his head on the mat. He was said to have been unconscious for eight minutes. At about this time he began having "blind spells." They usually occurred during the latter part of the day and were described as a sudden blurring during which everything turned a homogeneous gray color for about fifteen seconds when sight would slowly clear. There meanwhile had been a perceptible loss of visual acuity and for three months a tendency to diplopia. He had seen three different "eye specialists" who prescribed glasses, exercises for the strabismus, etc. There had been no headaches, vomiting or discomforts of any kind and only on close questioning was a tendency to being unsteady on his feet admitted by the boy who ascribed it to his seeing double. He

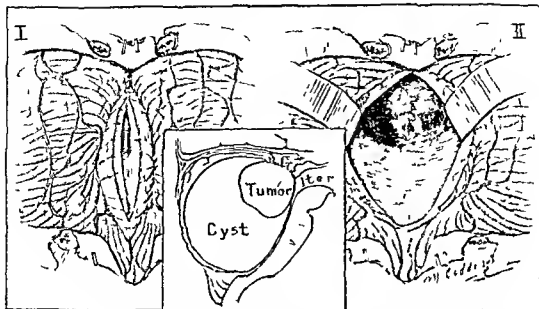


Fig 20 (Case 54) Showing a case similar to that in Figure 19 with tumor nodule attached to the upper thin wall where vascularity is likely to give trouble [Ref p 161]

nevertheless had continued in attendance in high school till shortly before admission which had been precipitated by his failing vision.

Examination showed a healthy appearing lad with a choked disc of five diopters in the stage of beginning atrophy, a slight left internal strabismus and definite nystagmus. Tests for cerebellar function were all negative except for slight possible unsteadiness in standing tandem with closed eyes. Cranial roentgenograms showed convolitional atrophy and questionable thinning of the bone in the suboccipital region where there was tenderness on pressure.

At operation, apart from demonstrable hydrocephalus and a definite pressure cone, no abnormalities were disclosed and exploratory punctures of the hemispheres were negative. A rapid subsidence of the choked discs with preservation of 20/70 acuity followed this procedure which amounted merely to a decompression.

Nearly three years elapsed when on November 17, 1924, he reentered the hospital because of the recent onset of suboccipital headache and projectile vomiting with fullness of the suboccipital region. During the interim, despite his impaired vision, he had been earning a modest livelihood as drummer in an orchestra of sorts. Apart from some slight unsteadiness, continued periodic diplopia and marked constipation, he had considered himself reasonably well. Examination at this time showed, in addition to his moderate secondary optic atrophy, definite cerebellar symptoms with nystagmus, a positive Romberg, and considerable inco-ordination.

At a second operation, a xanthochromic (40 cubic centimeters) cyst was detected in the left hemisphere

and a horizontal incision was made down to it. On widely opening the cyst, glommatous tissue was seen on its mesial surface. In attempting to remove the growth, it was found to extend down to an inaccessible depth in the midcerebellum, and after a prolonged session the extirpation was abandoned short of completion.

Following this operation, there was a remarkable and prompt subsidence in all the cerebellar symptoms. He was given a series of X-ray treatments and discharged December 23, 1924, in excellent condition. During the next year while the X-ray treatments were being kept up, he was seen a number of times with his symptoms about stationary.

He was re-admitted to the hospital shortly before Christmas of 1925 because of increasing instability, an accentuation of his diplopia, and a sudden right facial paralysis. He was allowed to go home for the holidays and his reentry for some unfortunate reason was delayed until February 12, 1926. On the night of his admission after a severe attack of vomiting, he became suddenly cyanotic and died shortly after from respiratory failure with a rectal temperature of 109° F. There was no postmortem examination.

The chief reason for this recital is to emphasize that the symptomatic onset may relate to vision alone. The anamnesis, to be sure, cannot always be depended upon. The parents of this particular lad were neglectful (he was one of several children) and it is quite probable that symptoms dating from child

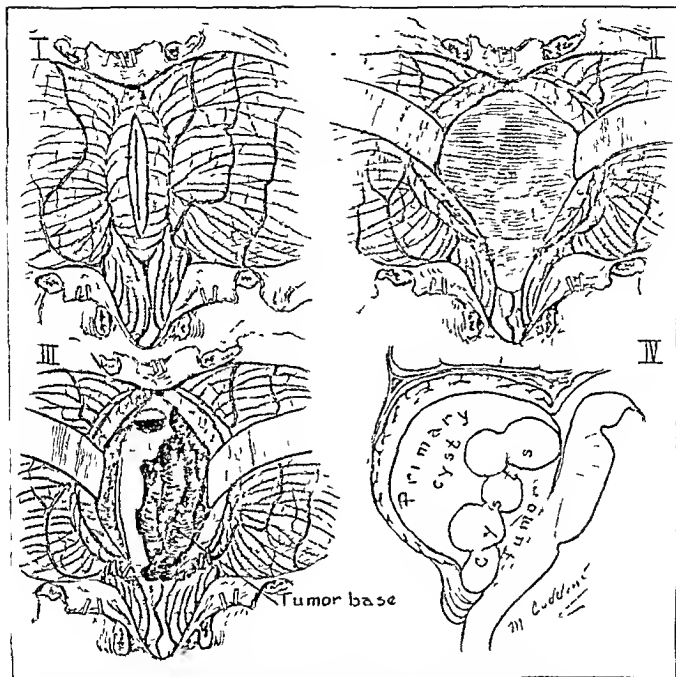


Fig. 21 (Case 50) Showing I, the bulging vermis incised, II, the median cyst fully exposed, III, the residual laterally adherent tumor incompletely removed, IV, diagram of the tumor on median section [Ref p 161]

hood may have gone unobserved or were forgotten.

There, however, are other interests in the case apart from the unusual chronology of symptoms. Among them are (1) the fact that after the first and negative exploration the patient remained symptom free for so long a time that the contemporary surgical diagnosis of chronic arachnoiditis or pseudotumor was thought thereby to be sustained,

(2) the fact that the cyst was opened at the second operation by a transverse cerebellar incision which rendered impossible a total extirpation of its deep lying and solid portion, and (3) the following facts regarding the pathological diagnosis, for in 1924 there was uncertainty as to whether the lesion was a fibrillary glioma or gliosis in the wall of a cyst. In 1925, Dr Bailey recognized its astrocytomatous nature and classified it as

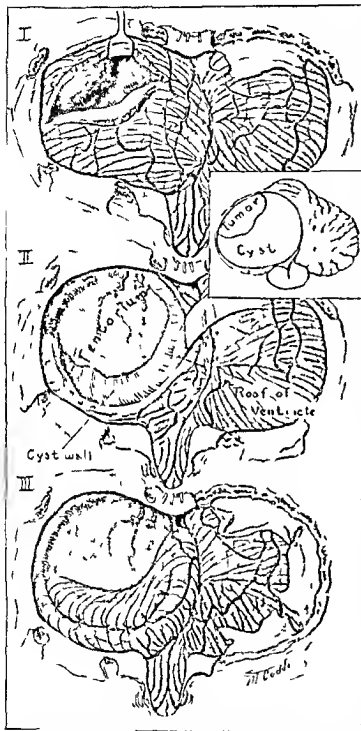


Fig 22 (Case 66) Showing I large lateral cyst with nodule underlying tentorium II cavity after extirpation III the replacement and suture of the collapsed hemisphere Sub sketch shows relation of cyst to roof of ventricle [Ref p 161]

protoplasmic, and we now look upon it as an astrocytoma which is sparsely fibrillary. But however classified the lesion was benign and might have been exposed and successfully removed at the first session had we known in 1921 what we were soon to learn.

How relatively mild the symptomatic picture may be even in the presence of a central lesion of magnitude is illustrated by the story of the child whose massive tumor, as revealed at autopsy, is shown in Figure 15.

CASE 68 An eight year-old school girl from a remote country district in Vermont was admitted on December 17 1929. At the age of four she had unaccountable diurnal bouts of headaches and vomiting which continued over a period of six months. There followed a six months period of complete freedom when the attacks began again and lasted for four months. She was then said to have remained apart from an occasional complaint of stiff neck, perfectly well and active for the next three years. Two months before admission the well remembered headaches and vomiting returned with increased intensity and for the first time instability was observed.

Examination showed a little girl with the by now familiar symptomatology of a median cerebellar tumor in stability ataxia and inco-ordination chiefly affecting the lower extremities with hypermetria and hypotonicity but with no nystagmus a positive Romberg with tendency to fall backward, a bilateral choked disc with secondary optic atrophy but with essentially normal vision. The head was not apparently enlarged, there was no tenderness or MacEwen's sign on percussion the X ray showed no evidence of hydrocephalus nor enlargement of the pituitary fossa. Reflexes were all within normal limits.

During her attacks of morning vomiting and headache she was inclined to assume an opisthotenoid position but there had been no cerebellar seizures. The fact shown by the Table that the operation was not carried out until ten days after admission indicates that the case was not regarded as urgent. There nevertheless proved to be a compact

median tumor of unusual size (cf Figs 14 and 15)

All things considered, it is fair to say that up to the point when one of these tumors attains such a size as markedly to flatten the medulla with the production of cerebellar seizures and their threat of respiratory failure, the local symptoms in the general run of cases may be surprisingly inconspicuous. To be sure, when there is a large cyst which comes to bulge, as it often does, into one hemisphere more than another, not infrequently carrying the mural tumor with it, the cerebellar syndrome may show unilaterality in favour of the right or left side and nystagmus may be expected.

Even though the astrocytomas tend (cyst included) to be lesions of greater magnitude than the average run of medulloblastomas, what chiefly distinguishes them from tumors of the latter type is not only their longer course but their intervals of comparative symptomatic freedom. This may conceivably be due to alterations from time to time in the degree of tension of the cyst, but as previously stated, it is with greater probability ascribable to the varying degree of tension of the hydrocephalic ventricles which at times press downward upon the tumor more severely than at others. It is this compression from above which leads to the more serious symptoms and in the terminal stages provokes the critical cerebellar seizures.

Anything which tends to increase this intraventricular tension, like compression of the veins of the neck, greatly aggravates the symptoms. So does coughing or sneezing or straining at stool, this having much to do with the constipation of which most of these patients complain, and I have known a child to die from respiratory failure following a cerebellar fit brought on by the effort to expel an enema.

It is the hydrocephalus, moreover, that is responsible for the most serious symp-

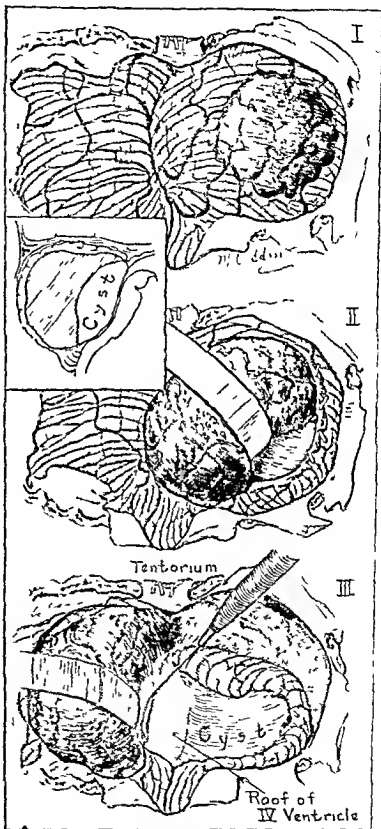


Fig 23 (Case 30) Showing (2½ nat size) I, large surface tumor exposed in right hemisphere, II, reflection of growth opening underlying cyst III, bulging roof of ventricle in bottom of cystic cavity [Ref p 161]

toms of all from the standpoint of a useful life after a successful operation namely, blindness. It was stated in connection with the 61 cerebellar medulloblastomas that impaired sight was noted at the time of admission in 26 cases, 9 of whom were already blind. This calamity, as might be expected from their more insidious advance, is still more commonly met with in patients with astrocytomas 40 of the 76 patients having had impaired vision at the time of admission, 22 of them having already become blind or nearly so. As all but the two infants had at the time of admission an advanced degree of choked disc, it is safe to say that they would all shortly have become blind without operation. This is a serious reflection on our diagnostic shortcomings and merely goes to show that medical practitioners have not as yet become as awake to these tumors of childhood as they have to the prevalence of cerebral tumors in adults.

6 PHYSICAL EXAMINATION

The physical signs are essentially those characterizing the medulloblastomas. Indeed, when there is nothing in the history to suggest a symptomatic onset exceeding the usual six to twelve months, the two conditions when the patients first come under observation may be symptomatically indistinguishable. They are apt to be well nourished, placid, friendly, co-operative children who quickly become ward pets. They may possibly have learned to avoid ill temper and crying lest it increase headache and they usually submit to operations under local anesthesia with surprising fortitude. Such ataxia as may be present chiefly affects the lower extremities, they walk cautiously with a broad base. The head is large and gives Macewen's "cracked pot" note on percussion. There is often suboccipital tenderness but in view of the usual median position of the growth tilting of the head is not noticeable.

The indications of cerebellar involvement are now too well known to need particular comment other than to recall the fact that they may be inconspicuous and that nystagmus is often wholly absent or represented merely by a few fine poorly sustained twitches. The hydrocephalic expansion of the head is

often so out of proportion to the determinable cerebellar signs that recourse may have to be had to preliminary ventriculography. This may be necessary to eliminate a possible tumor of the third ventricle which is no less likely to cause a secondary hydrocephalus, and both conditions naturally lead to demonstrable expansion of the sella turcica. When this procedure reveals normal filling of an expanded third ventricle, it should be followed by operation without delay, as the ventricles customarily refill tighter than before in a few hours' time. Should this rule not be followed, serious consequences may sometimes ensue as exemplified by the following record.

CASE 57. A young woman 27 years of age blind from secondary atrophy, was admitted May 11, 1928 with an obscure history of recurrent headaches and vomiting since early childhood. Her age was against a cerebellar tumor and the symptoms were sufficiently obscure to make desirable the added information from ventriculography, a marked hydrocephalus with no filling defect of the third ventricle being disclosed. Surgical intervention was postponed and that night she had a serious and her first cerebellar convulsion which forced us into an emergency operation the following morning. By good fortune a cystic lesion (Fig. 10) was found with a small laterally placed nodule easily accessible to electro-surgical removal without opening into the fourth ventricle.

The clinical picture presented by patients admitted with the syndrome highly advanced—when they have become blind, bedridden, and stuporous, have projectile vomiting, show oculomotor and possibly facial palsies, when recourse must be had to nasal feeding owing to the difficulty of swallowing, and when a cerebellar seizure may be provoked by some sudden passive movement of the patient's head—all this, which portends a sudden exitus and makes surgical intervention exceedingly hazardous, need hardly be gone into in detail.

7 MORBID ANATOMY OF THE LESION

The adaptability of the body to slowly developing pathological processes is well known but that tumors of such magnitude in such a critical situation and so certain to produce early hydrocephalus can be tolerated for so many years with so comparatively insignificant symptoms is a continued source of astonishment. What is no less remarkable is the

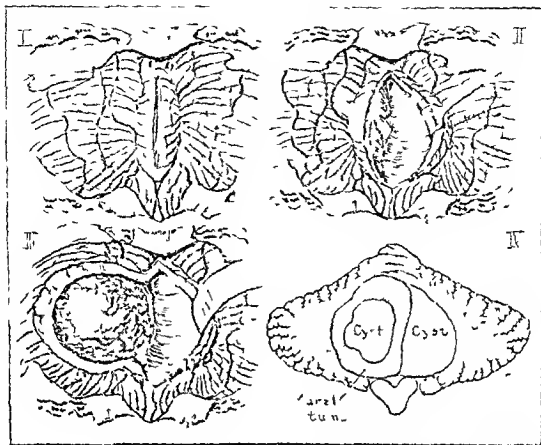


Fig. 24 (Case 62) Showing I, the exposed field with incised vermis II, the open cyst and laterally placed tumor III, the left hemisphere "uncapped" to give proper access to growth for its enucleation, IV, diagram of imaginary cross section [Ref p 162]

fact, betrayed by the tabular list, that in six of the early cases the tumor was not found at the primary exploration. To this oversight a number of factors doubtless contributed, the more important being the surgeon's failure understandingly to scrutinize the median structures of the exposed posterior cerebellar surface for any deviations from the normal topography. Another element lay in the fact that the essentially mesial position of the lesion was long unappreciated, little or no attention having been paid to abnormal prominence of the vermis, which, indeed, owing to the routine procedure introduced in 1910 of lowering tension by tapping the cerebral ventricle before opening the dura, might for the moment have lost what degree of prominence pre-existed. Still another factor in causing these deep lesions to be overlooked or misjudged was the universal custom, when no surface lesion was apparent, of puncturing the lateral cerebellar hemispheres in the hope

of striking and evacuating a cyst, their frequent occurrence in the cerebellum having become well known. Indeed, a palpable cyst, pointing in one or the other hemisphere, might have been laterally opened with no conception of its source of origin and of what lay behind it.

The appearance at operation. With the alterations in surface topography, so important to the surgeon, the pathologist does not concern himself, nor would the minor distortions be sufficiently well preserved in a cerebellum containing one of these tumors even had the brain been hardened *in situ* before removal. Moreover, the surgeon must bear in mind that a cerebellum with no external evidence of distortion or tension may yet contain a deep median tumor only to be disclosed by median transection of the vermis, and the courage to take this radical step will depend on the degree of dependence one places in his pre-operative diagnosis.

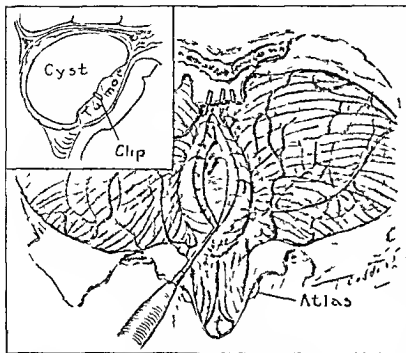


Fig 25 (Case 43) Condition found at original operation in 1925 the mural tumor having been left undisturbed owing to its vascularity [Ref p 162]

From what is essentially a normal appearing posterior cerebellar surface with a wholly concealed tumor one meets with all manner of variations up to huge centrally placed, fully exposed lesions either solid or predominantly cystic. Selections from the sketches of the fields of operation will serve better than descriptions to show some of these variations. The drawings at the same time illustrate certain stages in the surgical procedure, which will be touched upon here with brevity and only in so far as they are of primary pathological interest.

In the obscure cases particular attention should be paid (1) to the extent, character, and relative asymmetry of the tonsillar herniations, and (2) to the degree of prominence of the vermis and the relative widening of its convolitional folia. At secondary operations, because of protrusion, adhesions and surface cavities full of trapped arachnoid fluid, these finer points are necessarily lost and it is important that they should be carefully observed at the primary exposure. At no later session will the conditions be so favourable for

a clean cut enucleation of the growth.

The non cystic tumors
Though the majority of these astrocytomatous tumors in the cerebellum are in some degree associated with cysts, the lesions of compact type which are more difficult to deal with may deserve primary consideration. They are essentially median lesions which goes to show that the predominantly cystic tumors have acquired their more noticeable asymmetry of position through the tendency of the cyst to expand into one hemisphere more than the other.

In Figure 11 is shown the fairly normal appearing cerebellar surface exposed in Case 69. The uvula, however, was slightly more prominent than normal and there

was moderate herniation of the tonsils. The tumor which was wholly concealed and non cystic would easily have escaped detection by the usual exploratory punctures through the lateral hemispheres. The growth, brought to view after incising the vermis at a depth of about a centimeter, was primarily excavated by "scalping" and its shell was then cleanly brushed from the adjacent cerebellum. Its removal was subtotal owing to the line of attachment along the left margin of the widely expanded ventricle, this residual fringe of the growth having been coagulated by the spray.

In Figure 12 from Case 64 is shown a similarly hidden and much deeper lying tumor which, however, proved not to be wholly concealed. The degree of herniation of the tonsils was such that before they could be liberated a laminectomy of the atlas was necessary. On then drawing the tonsils apart a small nubbin of tumor was visible at the calamus where the posterior end of a medulloblastoma can so commonly be exposed. Transection of the vermis was carried to a depth of two centimeters before the tumor,

capped by a small cyst, was laid bare. The growth was soft and suckable and was at first mistaken for a medulloblastoma. It was cleanly removed with complete relief of tension as shown (compare Fig. 47) by the marked sagging of the hemispheres from the tentorium. The widened fourth ventricle was fully exposed from calamus to dilated aqueduct.

In Figure 13 from Case 70 is shown a much larger tumor of the same non-cystic type in which the vermis was a little more prominent than in the foregoing case. Here again a laminectomy of the atlas was called for to permit release of the tonsils and on separating them the lower pole of the tumor was similarly brought to view. On then splitting the vermis and brushing the hemispheres to the side the surface of a large, firm, non-cystic tumor was exposed. The extirpation was abandoned short of completion a shell of the growth having been left overlying the roof of the ventricle.

In Figure 14 from Case 68, an example is shown of one of these median, essentially non-cystic tumors of predominantly fibrillary type which has crowded its way to the surface where it was covered by a thin film of scarcely recognizable nervous tissue and arachnoidea. The posterior end of the tumor, which contained a small localized cyst, projected through the foramen magnum and the arch of the atlas was removed to liberate it. The tumor on scalloping proved to be highly vascular and after a prolonged session the patient's condition forbade further progress. The excavated growth was firm enough to hold sutures which were drawn together to collapse the cavity. It was anticipated that this would facilitate removal at a second session. As a matter of fact, this step merely served so to straighten and elongate the residual portion of the growth that its lower pole was pressed against the medulla by the closure of the wound.

This false step unfortunately was the cause of an early respiratory failure.



Fig. 6 (Case 43) Patient aged 11 at time of discharge after first operation [Ref. p. 16.]



Fig. 27 (Case 43) The fresh specimen on removal showing effects of surface coagulation [Ref. p. 162.]

Fig. 27 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72 73 74 75 76 77 78 79 80 81 82 83 84 85 86 87 88 89 90 91 92 93 94 95 96 97 98 99 100

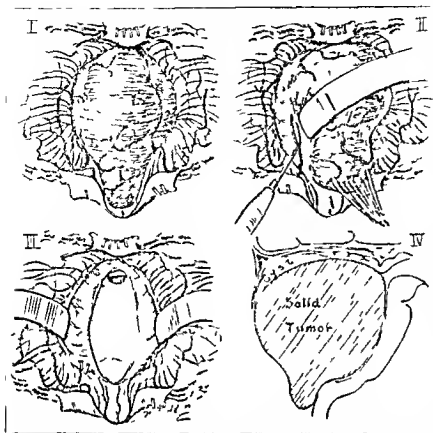


Fig 28 (Case 43) Showing condition at second operation (cf Fig 25) I the pear shaped tumor replacing former cyst II dislodgment of growth to side with primary incision into ventricle III terminal exposure of widely dilated ventricle IV, schema of assumed median section of lesion [Ref p 162]

The autopsy specimen from this case (Fig 15) makes clear that the excavation was far less complete than was believed at operation. The specimen serves at the same time to give an excellent idea of the size which one of these tumors may attain. The comparatively mild symptoms shown by the patient have already been alluded to in the section on symptomatology. The fact that there had been no pre-operative cerebellar rigidities or respiratory difficulty is the more remarkable when one sees to what an extent the entire brain stem has been dislocated forward. At one point, where pressed upon by a non adherent nodule, the medulla is scarcely four millimeters in thickness.

The lesion in Case 53, shown in Figure 16, was of similar fully exposed type but still larger in extent. The patient was a man 34

years of age with symptoms of long duration. A tongue of the non cystic and highly fibrillary tumor projected so far into the spinal canal that removal of the arch of the axis as well as of the atlas was necessitated. This sort of spinal extension being far more characteristic of ependymomas than of astrocytomas, the growth when first exposed was considered to be of the former type. The bulk of the tumor was electrically removed but the extirpation was left incomplete for the growth was adherent to the floor of the ventricle in the region of the calamus. Death occurred on the fourth day from peritonitis due to perfora tive duodenal ulcer.

Relatively small cysts, as shown by some of the preceding illustrations, are frequent accompani-

ments even of the essentially compact tumors just described. It is rare, in other words, to find an astrocytoma which does not show either on the surface or in its substance some evidence of cyst formation. A few examples of large cysts have already been cited in preceding sections of the text, and as pointed out in connection with Cases 1 and 2, the invariable presence of an underlying nodule of tumor and its actual relation to the cyst took many years to determine. This, which is so important from the standpoint of surgical pathology, deserves re emphasis here.

The predominantly cystic lesions. These, like the compact tumors just considered, may be wholly concealed or may lie fully exposed to view as in the case of the infant Matthews (Case 61) whose symptomatic story has been told (cf Fig 8). In that instance the lesion

lay exposed in the midline, but cysts of comparable size which are concealed differ from the solid lesions in that they are often asymmetricaly disposed, and come, for this reason, to be regarded as primarily hemispheric in origin. But even when so lateralized they will be found to extend well across the median line, and should the deeper mesial portion of the cyst-wall happen to be free of tumor the thin roof of the fourth ventricle, flapping with the respiratory movements, can usually be made out at the bottom of the cavity.

As shown in Figure 17 (Case 44), the presence of a concealed tumor was betrayed by a marked tonsillar herniation, more apparent on the left, and which should have been promptly released by removing the arch of the atlas. The vermis itself

was without prominence. On transecting the left hemisphere adjacent to it, a large (60 c cm) cyst, tumor-lined throughout was encountered. The tumor which proved to be psammomatous (cf Fig 46) was extirpated with difficulty because of its vascularity and the failure to approach it in the midline. The slow formation of an unsuspected post-operative clot was the cause of death at the expiration of twelve hours from sudden respiratory failure. The brain (Fig 18) furnishes a good example of a large pressure cone, the development of which may have been encouraged in this instance by the fact that the patient had been subjected to a succession of lumbar punctures before his hospital admission.

But this type of tumor lined cyst is unusual. It is far more common to find a definitely nodular and well localized area of mural tumefaction. These mural nodules vary greatly in size, some of them being no larger than a lima bean, others as large or larger than a hen's egg. The succeeding sketches will indicate how variable may be the disposition and size of the mural lesions.

In Figure 19, from Case 55, one sees a hulging vermis betraying a central lesion



Fig 29 (Case 43) Patient aged 15, on discharge after secondary operation for removal of large astrocytoma which had replaced original cyst (cf Fig 26) [Ref p 163]

A large cyst (75 c cm) was opened and a small easily accessible mural tumor was disclosed. The nodule overlay the headward part of the ventricular roof which was necessarily opened in the process of the extirpation. There has been no symptomatic recurrence in this case for nearly three years and none may be expected.

In Figure 20, from Case 54, the external appearances were essentially the same as in the last example but the mural nodule was attached to the upper surface of the cyst wall where from inaccessibility its removal was followed by bleeding from the leptomeningeal vascular attachments to the margin of the incisura, which was difficult to control.

Occasionally the tumors may be multicystic, as indicated in Figure 21 from Case 59, a congeries of "daughter" cysts having been exposed at the base of the large centrally disposed lesion. The tumor nodule was thought to be adherent to the right lateral floor of the ventricle and was incompletely removed.

In Figures 22 and 23 from Cases 66 and 30 are shown examples of what would appear to be laterally placed cystic tumors, one in the left and the other in the right hemisphere. In both instances the conditions were favour-

able for an approach to the mural growth by incision directly through the hemisphere. The relation of the cyst to the fourth ventricle is diagrammatically shown in Figure 22 by the sub sketch and in Figure 23 by the thin, intact roof of the ventricle which was bulging into the lower part of the cyst wall.

In Figure 24 from Case 62, a less common finding is shown. The prominent vermis betrayed a central lesion and on incising it a 35 cubic centimeter cyst was widely opened bringing to view a massive laterally placed mural tumor. It was necessary to "uncap" the left cerebellar hemisphere properly to expose this tumor and after its electro surgical extirpation it was found to contain a large central cyst. In Figure 50 a lesion of similar type is shown.

When the mural tumor occupies a median position (cf Fig 8) and is represented by a somewhat flat growth directly implanted on the roof of the ventricle, the surgeon may well hesitate to attempt its removal for the hazards are great and the mere evacuation of the cyst will of itself assure complete symptomatic relief for a number of years. What, however, is likely to happen so as to force his hand at a later session can best be told by the more detailed recital of an experience of this kind.

CASE 43. Median cerebellar cyst replaced four years later by compact tumor. Extirpation by electro surgical methods.

A girl 11 years of age, referred by Drs. R. C. Dodd and Frederick Tilney, of New York, was admitted August 7, 1925, with a history of symptoms of lully seven years duration.

In 1918 when four years of age, she began having morning vomiting with brief suboccipital headaches and a noticeable unsteadiness of gait. This kept up for six months but ceased following a single osteopathic (sic) treatment. After a six months' interval the attacks returned again and periods of this sort of thing looked upon as 'cyclic vomiting,' continued off and on during the next two years.

In June, 1922 the symptoms became aggravated and there were occasional attacks of unconsciousness following severe bouts of vomiting. The symptoms subsequently grew worse, there was diplopia, in crease of staggering and she was found to have a choked disc. By the autumn of 1922 all these symptoms had disappeared and for the next two years, apart from occasional nausea, she was symptom free and attending school with additional music and dancing lessons. During the autumn of 1924 and the following winter there were occasional reminders

of her former attacks and in May of 1925 they returned in full force with blurring of vision, instability, diplopia, nystagmus and a return of the choked disc.

Examination on admission showed a winsome and co-operative child with an enlarged head giving Macewen's sign, a choked disc of 3 diopters with some secondary pallor, a fairly well sustained fine nystagmus, a positive Pomeroy and unstable gait with tendency to deviate to the right, definite ataxia with hypotonia and dysmetria of the extremities more particularly of the legs, sluggish superficial and deep reflexes. These symptoms however, exhibited considerable variability from day to day.

Operation. On August 11, 1925 the usual bilateral flap exploration was made, great difficulty being encountered from extracranial bleeding. On opening the dura (Fig 25) a bulging vermis was disclosed with such markedly herniated tonsils that the laminae of the atlas were promptly removed. A median incision in the vermis brought to view the wall of a large cyst which contained 75 cubic centimeters of sherry coloured, non clotting fluid. At the base of the cyst overlying the fourth ventricle was a flat mural growth with a reddish granular surface. The growth proved to be so vascular that only a fragment was removed for histological examination. The walls of the cyst were then fixed by 40 per cent formalin until they became puckered and leathery. A silver clip was closed at one point on the surface of the tumor to serve as the telltale of any subsequent change in the position of the lesion.

Convalescence from this operation was without incident, pressure symptoms were promptly relieved and the cerebellar signs rapidly diminished. She was discharged on September 2, 1925 in excellent condition (Fig 26).

Interim history. For the next three and a half years she remained essentially symptom free, grew rapidly, attended school, engaged in such sports as skating, skiing, dancing and diving at which she excelled. In May, 1929 the old symptoms began to reappear—slight morning headache, diplopia and some instability. She reentered the hospital on June 3 and was found to have a beginning choked disc and unmistakable evidence of recurrence in the cerebellar symptoms. There was no suboccipital protrusion, the old defect having become reossified. The X ray showed that the clip placed on the surface of the tumor had been pushed outward.

Second operation. June 13, 1929. Under local anesthesia on reflecting the original flaps a large centrally disposed solid pear shaped tumor was brought to view. It was sufficiently firm to permit of its holding traction sutures and of being enucleated intact (Figs 27 and 28), there being only one moment of anxiety in the long four hour procedure due to bleeding from the anterior tentorial veins which were luckily caught by clips.

There was a sharp postoperative rise in temperature to 106° in three hours but this was overcome. Though the cerebellar ataxia had been accentuated

by the operation, at the time of her discharge on July 6, 1929, these symptoms were receding and her general condition left nothing to be desired (Fig 29). At the present time, fifteen months later, there is a residual slight diplopia, some trifling incoordination of the right hand, and a little unsteadiness, but she has passed the summer in a girls' camp riding horseback, and engaging in the usual activities of girls of her age.

Evolution of the cyst

The relation of the cysts to the tumor which has taken so long to determine is sufficiently well illustrated by the examples cited. Certain tumors tend to

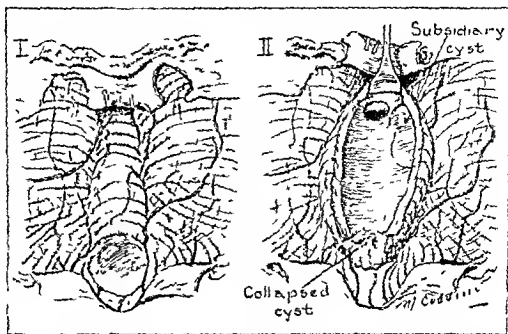


Fig 30 Symptoms of many years' duration supposedly due to multiple sclerosis. Operation disclosing I, widely distended vermis with local cyst at situation of ca anus, II, enormously distended ventricle with secondary xanthochromic cyst attached to its wall [Refs this page and 170]

exude plasma from their surface and the resultant xanthochromic fluid becomes encysted, the cavity becoming lined by a glistening non-absorbing membrane such as quickly surrounds fluid trapped in tissues anywhere. The chemical composition of the fluid shows it to be nothing more than a capillary transudation which may or may not undergo spontaneous coagulation and which varies in colour from a light canary yellow to the colour of sherry wine. That this exudative tendency of the tumors may have something to do with their vascularity is suggested by the fact that haemangioblastomas are particularly prone to form large cysts. After mere tapping and evacuation, the cyst eventually refills unless the mural tumor has been removed when the formation of fluid ceases even though the cyst wall remains. Hence the membrane does not secrete—only the tumor.

Cavitation through degenerative processes may of course take place within the tumors themselves and cysts of goodly size thus be formed (cf Figs 24 and 49), but this is uncommon and cysts wholly within tumors never reach the same magnitude as do enveloping cysts. What is more, they are not lined by membrane and they do not appear to acquire the same degree of tension.

It is of course conceivable that a tumor may wholly disappear through cavitation and ultimate absorption and leave nothing but non-secreting, empty cavities without trace of the original growth. There are two cases in our original series, both of them adults, in whom after many years of symptoms a cerebellar lesion had become symptomatically stationary. In one instance it was an accidental postmortem finding in a patient with acromegaly. In the other, two thin-walled xanthochromic cysts of the fourth ventricle were disclosed at operation (Fig 30), both were evacuated without disclosing a mural nodule and without in any way whatsoever altering the long-standing mild cerebellar symptomatology. Though both of these cases had come to be incorporated in our series of fibrillary astrocytomas, we have been unable to convince ourselves on restudy of the tissues that they show anything more than some reactive pericystic gliosis—certainly nothing definitely astrocytomatous.

If the tumor has died out in these cases it certainly is not what usually happens. Quite to the contrary, a small mural tumor identified but not removed at a primary operation usually comes in time more or less completely to replace the cyst. Whether the evacuation



Fig. 31 (Case 41) One of several masses of the large central tumor that was fragmented in removal. Note smooth surface of these lesions as brushed from cerebellum

of the fluid may have allowed the growth more rapidly to expand, or whether the intracystic tension may tend so to interfere with its nutrient blood supply as to diminish vascularity and discourage its growth, are queries that are unanswerable. The enormous size which may ultimately be attained by the cyst replacing growth is exemplified by the following case:

CASE 41. A child three years of age, operated upon in October 1924, proved to have a laterally placed, 80 cubic centimeter cyst opened by incision in the right hemisphere with only fragmentary removal of the deeply lying, awkwardly accessible mural tumor. Three years later, in December, 1927, for recent recurrence of symptoms a secondary operation was performed with radical extirpation of a huge tumor. The growth was non-adherent and it was removed piecemeal in large masses (Fig. 31), the last fragment having been dislodged from a pocket well above the level of the incisura (Fig. 32). A postoperative fatality from hyperthermia occurred 48 hours later.

One more point should be mentioned before closing this section, namely, that astrocytomas, recurrent after primary incomplete operations, may come to be attached to the floor of the fourth ventricle thereby greatly increasing the hazard of subsequent attempts to extirpate them. This the following case illustrates.

CASE 22. A boy 14 years of age with inconspicuous cerebellar symptoms was operated upon in March, 1921. After negative punctures of the lateral hemispheres a chance tap through the vermis at a depth of 2 centimeters entered a 10-cubic centimeter cyst which was evacuated.

Eight months later in November, 1921, he was readmitted because of a return of symptoms with suboccipital protrusion. On re-exploration the cyst was found replaced by a central tumor mass which was incompletely extirpated. The lesion was diagnosed as a protoplasmic astrocytoma and a series of X-ray treatments was given.

After six years of symptomatic freedom on November 3, 1928, a third operation was performed and a huge recurrent growth was encountered. By this date the essentially benign nature of the lesion was understood and the attempt was made entirely to remove it. This had to be abandoned short of completion, a single nodule of tumor having been left at the region of the calamus.

Three weeks later, the patient having made an excellent recovery, a fourth operation on November 28, 1928, was foolishly undertaken in the vain hope that the remaining nodule (cf. Fig. 33) might have become dislodged so that it could be removed (cf. the surgical experience in Case 40). This was found to be impossible and resultant bulbar symptoms led to the patient's death five days later.

8. CYTOLOGICAL CHARACTERISTICS

As mentioned in the introductory section, Professor Councilman in the early years of the hospital had taken great interest in the gliomas submitted to his department for diagnosis. In his contemporary highly detailed descriptions with photomicrographs of sections stained by phosphotungstic acid hematoxylin, the tumors we now call astrocytomas, even had we not seen fit to re-examine them by more modern methods during the course of our subsequent review, are so well depicted as to be unmistakable. From the tabular column of contemporary pathological diagnoses for the years from 1913 to 1916, it is evident that he had laid emphasis on the fibrillary character of many of the lesions, but not until after 1923 does the histogenetic type of the tumors begin to be recorded with a distinction drawn in the case of the astrocytoma between fibrillary and protoplasmic varieties (cf. Table of Cases).

Nothing can be of greater value to a surgeon than the ability immediately to visualize from the gross appearances of a tumor what will be its histological nature. Too great



Fig 32 (Case 41) To show (nat size) the right lateral bed of tumor which has extended through the incisura and overlies the corpora quadrigemina. Note (1) that roof of fourth ventricle has been removed from corpora to vermis (2) the forward displacement and vertical position of the brain stem, (3) the intact floor of fourth ventricle [Ref p 164]

emphasis cannot be laid upon this. When, however, dependence was had upon the long delayed pathological reports, which tissue fixation and sectioning and special staining demanded, one's memory of the lesion as seen at operation had become so obscured by intervening experiences and impressions, it was impossible satisfactorily to couple its finer architecture with the appearance in the living. Not until the supravital technique (cf Fig 34) came within the past few years to be routinely employed for purposes of immediate diagnosis have our difficulties on this score been largely overcome, and further experience with this technique for purposes of immediate tumor differentiation makes it possible to lay still greater stress upon its

value than was justified even a year ago in the discussion of the medulloblastomas. This method, which has been described elsewhere (10), enables one to see the intact cell with its cytoplasmic processes intact and well spread whereas on sections it is mere chance that the cell should happen to lie largely in the plane of the cut tissue. Astrocytes are so characteristic as to be unmistakable either in a fresh smear or in fixed-tissue sections, but those shown by the latter method are so shrunk by fixation they are as different from the living cell as is the raisin from the grape.

From the disposition, external appearance, consistency and other qualities of most cerebellar astrocytomas, we may now, in the majority of cases, make a close guess at the time

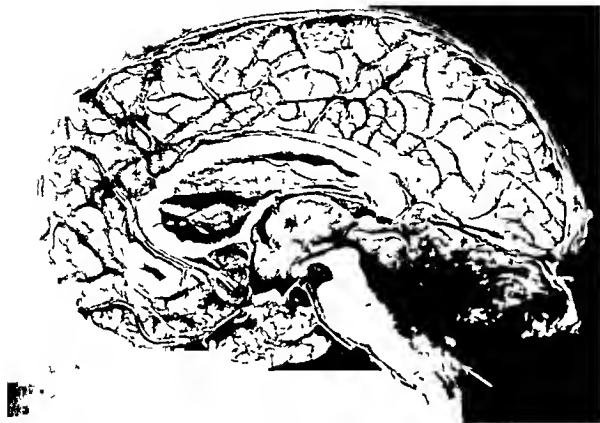


Fig. 33 (Case 22) Brain of patient originally operated upon in March, 1927, when cyst punctured. Six months later partial incomplete extirpation of tumor. Relief for seven years before return of symptoms. Radical extirpation attempted. tumor found adherent to floor of fourth ventricle (arrow) fatality. [Ref. p. 164.]

of the operation as to what the microscope will show. A large xanthochromic cyst with a definite, fairly firm, sometimes even rubbery mural tumor of low vascularity can hardly be anything else. Indeed, the nature of the lesion may be so unmistakable that when an equivocal report is returned from the laboratory, subsequent study not infrequently settles the matter in favour of the operative diagnosis. The column in the Table recording the presumptive naked eye diagnoses will show that since the tumor in Case 53 was mistaken in November, 1927, for an ependymoma, the correct anticipatory impression of the cytological nature of the lesion was had in all instances with the exception of the most recent one (Case 76) when at operation the lesion was looked upon as a probable angio-blastoma.

Rarely does one meet with a glioma of cytologically pure type. Even in the rapidly growing medulloblastomas, an occasional transition of the primitive cells into spongioblast or even neuroblast may be found on smear (10), on culture (11) or in the sections (12). This is no less true of the astrocytomas in which not only are fibrillary and protoplasmic elements commingled in varying proportions but an occasional oligoglia cell may be clearly demonstrated by supravital technique (10). These rare elements, however, do not modify the pathological diagnosis for the principle of glioma classification is based on the predominating type of cell.

The cerebellar astrocytoma (and the same may be true of the cerebral ones as well though we have not as yet thoroughly re-studied the 151 tumors so listed) are in reality

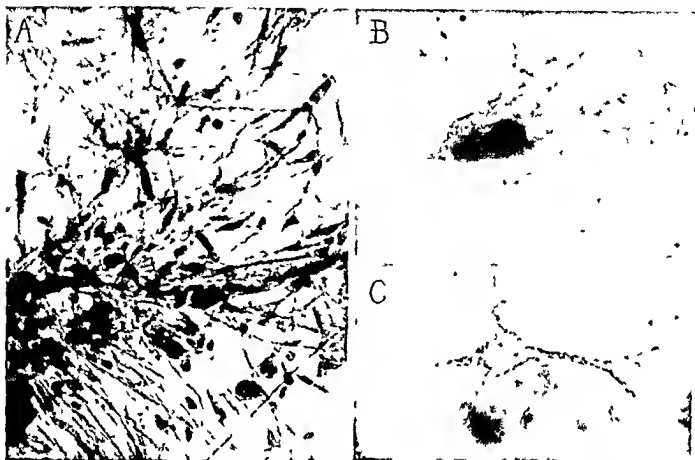


Fig 34 (Case 68) A, Supravital preparation of the densely fibrillary astrocytoma shown in Figures 14 and 15 (neutral red stain, $\times 300$) B, Protoplasmic astrocyte ($\times 850$) from same preparation C, Fibrillary astrocyte in supravital preparation from Case 73 [Ref p 163]

mixed tumors in most of which fibrillary and non-fibrillary astrocytes are found congregated in different areas (Fig 35) The relative proportion of the two elements can usually be anticipated by the consistency of the lesion as found at operation The tumor may be as dense as a fibroma and as difficult to "spread" but even when this is so the tangled fibrillary mesh is easily demonstrable (Fig 36) On the other hand, the growth may be so soft and "suckable" that, in the absence of an accompanying cyst or of tell-tale implantations, it is difficult surgically to distinguish from a medulloblastoma But these soft, loosely textured tumors composed largely of non-fibrillary (protoplasmic) astrocytes prove to have the same favourable prognosis, if properly treated, as do those in which fibrillary astrocytes predominate, and it is for this reason as stated in an earlier section that we no longer believe it to be necessary or profitable clinically to draw a distinction between them

The microscope, in other words, cannot tell the whole story and without clinical correlation one may be easily led astray by what it shows The experience with these tumors is reminiscent of the early attempts by pathologists to classify the acoustic tumors which were variously regarded as pseudo-gliomatous or fibrosarcomatous depending upon the particular portion of the growth which happened to be included in the microscopic preparation, these lesions like the astrocytomata being composed, in varying proportions, of two kinds of tissue differing greatly in architectural appearance Even in the solid and densely fibrillary tumors of the type grossly shown in Figure 15, there are loosely textured vacuolated areas which are sparsely fibrillary or which may show no fibrils at all (Fig 37) On the other hand, in not a few tumors, formerly classified as protoplasmic, further sections reveal areas which are either sparsely (Figs 38 and 39) or densely fibrillary Case 41 pro-

vides a good example of the latter, the fragment of tumor removed for diagnosis at the primary operation in 1924 having been called protoplasmic whereas the large tumor subsequently removed three years later proves to be about fifty per cent fibrillary (Fig 40). Only two (Cases 20 and 49) of the nine examples originally classified as protoplasmic are so free from fibrils in the sections as yet studied that they might justify being put in a separate category were it not that they show the same favourable prognosis on removal as do the highly fibrillated tumors. Case 49 which has already figured in the literature may deserve special citation in this respect.

CASE 49. A child eight years of age with the history of morning headaches and vomiting for a period of only six weeks was transferred to us from the Children's Hospital on September 27, 1926 where a 5 diopter choked disc had been found. Examination showed a hydrocephalic enlargement of the head and there were definite though inconspicuous signs including nystagmus pointing to a cerebellar lesion.

At operation on September 30 a highly vascular condition of the extracranial tissues was found necessitating early puncture of the hydrocephalic ventricle before the exposure of the cerebellum could safely be proceeded with. After removing the thin suboccipital bone and reflecting the dura the lower pole of a median tumor was seen projecting between the tonsils down through the foramen and a laminectomy of the atlas was made in order to liberate it. A central pear shaped tumor covered by a thin sheet of cortex was then exposed (Fig 41 A). Because of its highly vascular surface it was mistaken for an hemangioblastoma. It was found to be non adherent at the situation of the calamus where the lesion was partly cystic and a small fragment of the cystic tissue was removed for histological examination. It proved to be sclerosed cortex.

The child made an excellent recovery with subsidence of all symptoms and was given a series of six X ray treatments and discharged on October 28. By March of the next year headache and vomiting had begun to reappear and there was bulging of the suboccipital region. Her readmission was advised and with the newly introduced electro surgical methods it was hoped the tumor could be safely attacked. The growth possibly in consequence of the radiation, was found at this session after shrinking by surface coagulation to be sufficiently firm to be easily manipulated. It was removed *in toto* (Figs 41 and 42) with the usual wide exposure of the fourth ventricle.

From this operation the patient made an excellent recovery (Fig 43) and remains symptom free now

three and a half years later. The tumor after fixation and sectioning proved to be an astrocytoma composed almost wholly of protoplasmic elements only an occasional fibril being evident in the single block which has been cut (Fig 44).

Other secondary features of these slowly growing tumors which may deserve mention are the tendency to hyalinization of the blood vessels (Fig 45) and the occurrence of spotty calcification (Fig 46) which in one instance led consequently to the roentgenological diagnosis of tuberculoma.

9 DIFFERENTIAL DIAGNOSIS

This has necessarily been touched upon from its several aspects clinical, surgical and pathological, in preceding sections. From a symptomatic standpoint a medulloblastoma tends on the whole to be much more rapid in onset and on the average to occur at an earlier age than the other types. In a recent case a medulloblastoma with spinal metastases has been verified by the finding of tumor cells in the cerebrospinal fluid, but this could scarcely be advocated as a routine measure for it is quite possible that the puncture would serve to dislodge cells from an intact tumor and disseminate them through the cerebrospinal spaces.

Attention may be called to the fact that, in view of the inconspicuous local symptomatology there may be difficulty in distinguishing between the hydrocephalus due to a tumor of the third *versus* tumor of the fourth ventricle. This uncertainty was recorded for Case 30 but most of the third ventricle lesions of childhood are congenital cysts arising from relics of Rathke's pouch and they usually show calcification. Another source of diagnostic error less likely to occur today than formerly is due to the failure to detect the presence of a concealed and deeply seated mid cerebellar lesion. This has led (e.g., Cases 28 and 36) to the diagnosis of pseudo tumor or chronic arachnoiditis in case the wall of the posterior cistern was found to be greyish and appeared thickened.

Roentgenotherapy might conceivably be called upon as a diagnostic aid in view of the known effect of the X ray in temporarily checking the growth of a medulloblastoma.



Fig 35 (Case 33) Showing in same section densely fibrillary area in sharp contrast with oedematous sparsely fibrillary area (P.T.A.H. $\times 150$) [Ref p 167]



Fig 36 (Case 77, not in series) The dense felt work of fibrils in a rubbery astrocytoma difficult to "spread" (supravital preparation, $\times 850$) [Ref p 167]

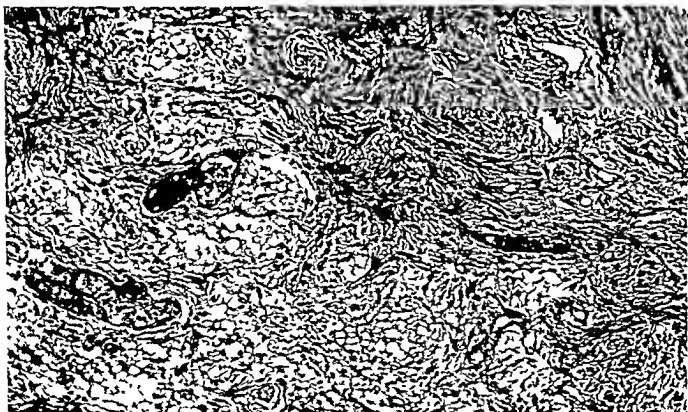


Fig 37 To show the architectural appearance of the densely fibrillary astrocytoma from Case 68 shown in Figure 15 (P.T.A.H. $\times 150$) [Ref p 167]

This recourse, however, would hardly serve the purpose of distinguishing between the two lesions in view of the known spontaneous remissions in the symptoms of an astrocytoma. Moreover, serious risks may be attached to the procedure. When there is a definite history of headache and vomiting with more or less notable remission over a period of years, one may feel reasonably sure he is not dealing with a medulloblastoma.

The lesions with which a cerebellar astrocytoma is likely to be confused when exposed at operation are the medulloblastomas, the ependymomas, angioblastomas, and possibly the papillomas which frequent the same mid cerebellar region. A percentage basis would speak in favour of an astrocytoma for in our series they occur in the proportion of 76 to 62 medulloblastomas, to 22 angioblastomas, to 18 ependymomas.

In the case of median tumors that are unassociated with cysts or in which the cystic formation is relatively inconspicuous, and particularly when the tumor is relatively soft and easily "suckable" as we say, there may be doubt as to its nature, many astrocytomas being sparsely fibrillary. On the other hand in the medulloblastoma report (2) examples were given of tumors that were sufficiently firm to be enucleated more or less intact. In short, the median cerebellar astrocytomas may be so soft and free from cysts as to suggest a medulloblastoma (e.g. Cases 45 and 50), so vascular as to suggest an angioblastoma (e.g., Cases 40 [cf Fig. 44] and 76), or so disposed as to resemble an ependymoma (e.g., Cases 34, 42 and 53 [cf Fig. 16]). The Table will show how often the operative diagnosis was misjudged in the past, and how free from errors it has been since the nature of the lesion in Cases 49 and 50 was misjudged.

An erroneous pre-operative diagnosis of tuberculoma was made in one instance (Case 71) by the roentgenologist on the basis of spotty calcification in the subtentorial region detected stereoscopically on the X ray films, but the clinical history and examination served to make it improbable. Calcification in the subtentorial region is difficult to detect and it has been observed only in this single instance though a number of the tumors have

shown calcification on microscopic examination. It, moreover, is common in the cerebellar ependymomas and too much stress for purposes of pre-operative differential diagnosis cannot be laid upon it.

Two other conditions may deserve mention. One of them is what is called chronic cisternal arachnoiditis which probably corresponds to what was once called pseudo tumor cerebelli for these conditions are apt to provoke symptoms that are suggestively cerebellar, it, however, is not a common condition in childhood though the Table will show that Case 28 after the primary operation was so diagnosed. The other condition may possibly be best designated as congenital cystic malformation with occlusion of the foramen of Magendie. In one instance of this sort in a child the pre-operative diagnosis of astrocytoma was made and at operation a small thin walled cyst similar to that shown in Figure 30 was found.

10. PHYSIOLOGY

Whereas localization of function in the cerebrum is of the utmost importance in determining the locus of its tumors, the same cannot be said of the cerebellum in spite of the most elaborate studies. We may often determine the laterality of tumors and may distinguish between primarily extracerebellar and primarily intracerebellar lesions. We may at times also make a close guess as to whether the lesion is essentially median in position and presumably by the predominance of vomiting in the symptomatology whether the brain stem is under compression, which it usually is in these midline tumors.

It has been learned that a surprising amount of cerebellar tissue can be experimentally removed from an animal without permanent disability and the customary "uncapping" of the cerebellum to get a satisfactory exposure of the familiar acoustic tumor is followed by no discernible subsequent instability unless the excision is made deep enough to damage the dentate nucleus or the peduncles. And as will be seen from the description of the operations for these astrocytomas, the vermis may be vertically split throughout its length so as fully to expose the fourth ventricle with no symptomatic trace of this radical procedure.



Fig 38 (Case 40) Sparsely fibrillary area in tumor which was formerly classified as protoplasmic (P.T.A.H. $\times 600$) [Ref p 167]



Fig 39 (Case 22) Sparsely fibrillary area from soft tumor showing single fibrillary astrocyte with stumpy processes (P.T.A.H. $\times 600$) [Ref p 167]

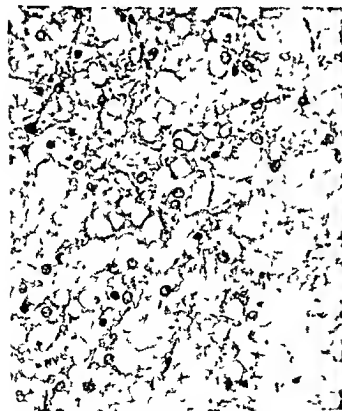


Fig 40 (Case 41) Fields from different areas of a typical mixed astrocytoma classified as protoplasmic from a small fragment removed at primary operation. Purely protoplasmic, left, densely fibrillary, right [Refs pp 167-8]

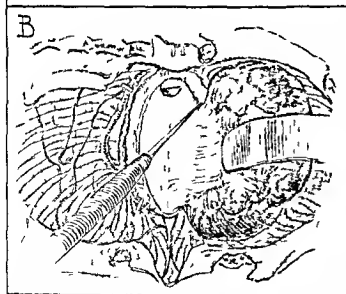
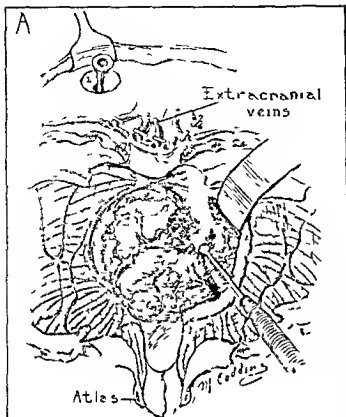


Fig 41. (Case 49) Showing A field at first operation in 1926 when a supposedly angioblastic tumor was exposed and its surface coagulated B the electro surgical removal of the intact tumor at a second operation seven months later [Ref p 168]



Fig 42 Tumor from Case 49 supposedly an angioblastoma shrunk by coagulation before removal (nat size) [Ref p 168]

What is more after the removal of huge recurrent cerebellar tumors little may be left but a mere shell of cerebellum and yet it may suffice for all practical purposes of equilibrium and muscle tone

Nor as a matter of fact, apart from an interest in cerebellar physiology, does exact localization or even lateralization of the lesion make a vast degree of difference to the surgeon since there is only one satisfactory way of surgically exposing the cerebellum and that is from behind and below the level of the lateral sinuses, the precise situation of the lesion being determined by a close scrutiny of the surface configuration for distortions by abnormal vascularity, by palpation and exploratory punctures. The subtentorial fossa is so comparatively small that an intracerebellar tumor of any sort and situation may exert pressure effects that are evenly distributed and apart from the possibly greater incoordination of legs over arms or of one side over the other, preliminary localization is scarcely determinable nor from an operative standpoint is it greatly needed. The particular tumors under discussion, in spite of their associated cysts which may bulge more markedly into one hemisphere than the other, are essen-



Fig. 43. (Case 49) Showing patient on discharge after second operation. Note depilation from six months of ineffective radiation (1926-1927), also absence of protrusion [Ref. p. 168].

tially median in position and the chief matter of neurophysiological interest is the fact that nystagmus may be inconspicuous or absent even though ataxia, which particularly affects the lower extremities, be of extreme grade.

That much might be learned of cerebellar function through the study of these cases by a physiologist whose interest lies in the nervous system goes without question, and the fact that a knowledge of their morbid anatomy rather than neurophysiology has to do with the successful treatment of these tumors should not be taken to mean that the opportunity of advancing knowledge of cerebellar function should be neglected.

II THERAPEUTIC CONSIDERATIONS

The brief notes in the Table under the caption "Operative Procedures" serve as milestones of our therapeutic progress, successive modifications in the surgical manœuvre having been necessitated as our knowledge of these particular tumors grew. Several periods correlated mainly to contemporary views of tumor pathology may be recognized. The dates will show when emphasis was laid almost wholly upon the cyst which was punc-

tured and evacuated, or laid open and treated by some tissue fixative, or in favourable circumstances excised, when it began to be apparent that recurrences were inevitable and it was found that the cysts were apt to be replaced by tumor, when the effort to identify the tumor for purposes of classification became a routine, when radiotherapeusis was given a trial, and finally, after the relatively benign nature of the lesions became apparent, when the importance of removing the mural nodule intact at the first session began to be appreciated. These several periods have been punctuated also by successive improvements in technique and it can be seen when ventricular punctures in course began to be used, when local anaesthesia was first employed, when the suction apparatus came into general use, when it came to be realized that the tumors were primarily median in position and overlay the fourth ventricle so that even when concealed they were best approached by a median transection of the vermis, and finally when electro-surgical methods came to simplify enucleation and hæmorrhage.

Radiotherapeusis Soon after the war, we began more or less routinely to subject pa-

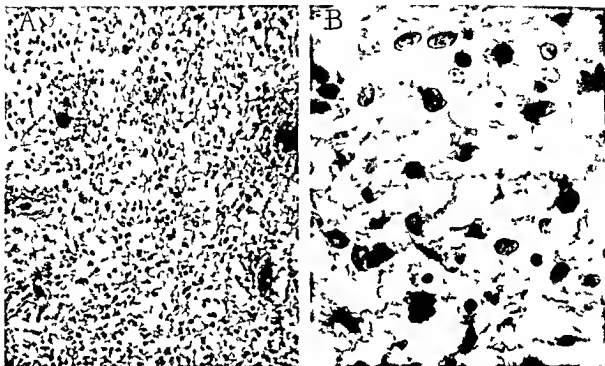


Fig 44 (Case 49) Vacuolated astrocytoma almost wholly protoplasmic A To show character of the lesion ($\times 150$) B Higher magnification ($\times 600$) showing sparse fibrils in lower corner of field [Ref p 168]

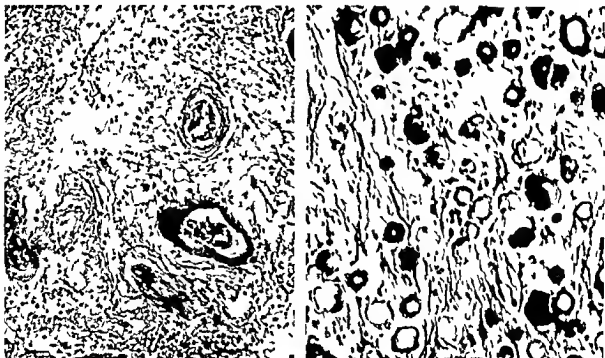


Fig 45 Showing in Case 72, characteristic hyalinization of blood vessels which in some tumors is very pronounced [Refs pp 168 and 188]

Fig 46 Showing in Case 44 the spotty calcification often seen in these tumors and occasionally detected by the X ray [Refs pp 161 and 168]

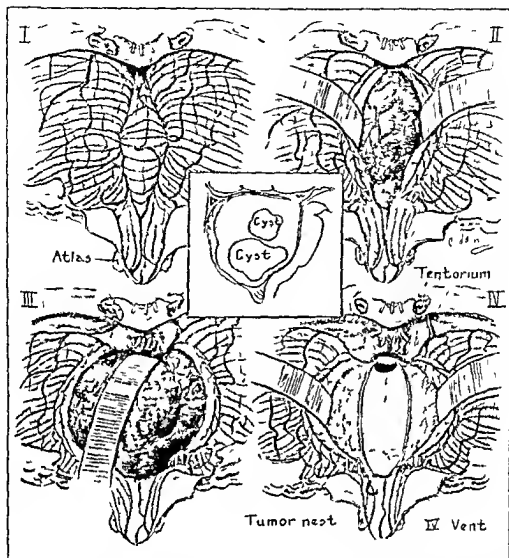


Fig 47 (Case 71) Showing I, the posterior cerebellar surface with prominent vermis, II, the tumor exposed after median incision of vermis, III, stage of difficult dislodgment from tentorium, IV, appearance of field at conclusion of operation with sagging hemispheres and edge of incisure exposed. Insert shows (cf Fig 49) the assumed lesion in sagittal section [Refs pp 185-6]

tients to therapeutic radiation after operations which had served to demonstrate the presence of a glioma. The results on the whole were looked upon as encouraging. The treatments at least did no harm and in the face of what was thought to be, at best, a malignant growth, they gave us a therapeutic straw to lean upon. Similar steps were being taken in other places and ere long articles were published advocating preliminary radiation before resorting to surgical intervention. The risks of so doing are now well known. Radiation of a tumor when effective, caused swelling of the growth and increased symptoms which may prove fatal in the absence of

a decompression. What is more, without some assurance of the histological nature of the lesion, from which alone some idea could be gained of its prognosis when unirradiated, the presumed effects were capable of misinterpretation. This is particularly true of tumors such as those under consideration whose symptoms are prone to show spontaneous remissions.

Gliomas which had been surgically verified and decompressed offered a more favourable opportunity to observe the effects of roentgenization, and the matter during the next several years was thoroughly put to the test by Dr M C Sosman, the hospital roent-



Fig 48 (Case 71) Patient on discharge 20 days after operation [Ref p 187]

genologist. From the notes in the last column of the Table it can be seen that during 1922-1924 (Cases 22-50) the patients with these cerebellar astrocytomas were commonly radiated, as was true of other verified gliomas. The susceptibility of the medulloblastomas to this form of treatment soon became apparent and for reasons now better understood the astrocytomas were long thought to be beneficially influenced. In September, 1927, a conjoint report of these experiences was given by Sosman, Bailey, and Van Dessel before the American Roentgen Ray Society (13). The conclusions then expressed were that roentgen therapy at best merely exercises a restraining influence on the more malignant types of glioma more particularly on the medulloblastomas to a less extent on the glioblastomas, and as was stated, some improvement had also been obtained with the protoplasmic astrocytomas whereas the more slowly growing tumors notably the fibrillary astrocytomas, remain uninfluenced.

This conservative statement would about represent our present day views with the inclusion of the more protoplasmic with the fibrillary types (at least of the cerebellar astrocytomas) for we would no longer think of sub-

jecting even them to radiation. It will be seen from the Table when our enthusiasm for this supplementary treatment began to wane. Cases 45 and 50 were so treated (and with presumed benefit) but that was partly because the lesions were mistaken at the time of operation for medulloblastomas and there was delay in getting a pathological report upon them. Cases 46 and 48 were also radiated from some misunderstanding, and Case 49 for the reason that the lesion was mistaken for an angioblastoma, a type of tumor somewhat amenable to roentgenization.

That a cerebellar astrocytoma whether predominantly fibrillary or predominantly protoplasmic, is wholly unaffected by radiation is at least something learned to lighten the labour of the roentgeno therapeutic department. Without a knowledge of the natural history of the tumor, regarding it simply as a glioma and consequently a lesion of malignant character, the results in many instances might well enough have been misinterpreted as triumphs of radiotherapy.

Pre operative therapy. Owing to the peculiarly insidious progress of these mid cerebellar astrocytomas, patients are apt to enter the hospital in an advanced stage of the process with seriously impaired vision, and a few days' unnecessary delay may mean blindness. If delay is unavoidable, recourse is had to salinization, preferably in children by magnesium sulphate enemata. The value of this procedure in lowering intracranial tension particularly when there is hydrocephalus can not be overemphasized, and it is not uncommon for bedridden and vomiting children to be up and playing about in a day or two so free from symptoms as utterly to belie the seriousness of their plight.

It has already been pointed out that intract-

able constipation is a customary complaint due partly to the fact that straining at stool for obvious reasons greatly exaggerates the headache. Caution should be given at the same time against the giving of large enemata. Nothing could be more dangerous for a patient in the stage of the malady in which cerebellar rigidities or actual (Jacksonian) seizures occur, than to be propped up on a bed pan and obliged to evacuate in this position an enema which causes uncontrollable peristaltic straining. Death has occurred under such circumstances



Fig. 49 (Case 71) The 51 gram tumor (nat. size) after transsection showing cystic cavities (cf Fig. 47) [Ref. p. 187]

in two (e.g., Case 15) instances and in earlier days when it was customary to give a pre-operative enema not a few patients had serious cerebellar seizures inopportunistically provoked thereby on the morning set for operation.

Another thing to be avoided and against which attendants are warned is the possibility of twisting the patient's head into a painful position in the process of shaving the scalp preparatory to the operation. A cerebellar seizure may sometimes be the consequence of this, and it is therefore wise in critical cases to carry out the shaving after the patient is in the comfortable face-down position on the operating table.

The anæsthetic. Most neurosurgeons have come round to what de Martel first strongly insisted upon—namely, that most cerebellar as well as other intracranial operations of other types could and should be carried out under local anæsthesia. It is remarkable how well patients, even young children, will endure these long procedures with scarcely any complaint worth recording. Not only does inhalation narcosis vastly increase the difficulties from extracranial bleeding encountered in the

preliminary stages of the operation, but it is highly dangerous from the standpoint of respiratory embarrassment particularly when the symptomatology of one of these fourth ventricle tumors is at all advanced.

It is our custom in most intracranial operations to give a preliminary dose of 0.3 milligrams of scopolamine with 10 milligrams of morphine shortly before the operation with another 5 or 10 milligrams of morphine in course if it is called for, but even this, when there is impaired respiration, may be precluded. The Table will show that since April, 1926, twenty-one of the operations have been conducted wholly under novocain infiltration. In another ten operations, restlessness or complaints or inco-operation on the part of the children have made it necessary to tide over difficult periods with temporary etherization. This we have occasionally given per rectum, but we usually prefer to use the rectum for a continuous Murphy-drop during the long session, a thousand cubic centimeters or more of fluid thus being given.¹

¹We have recently had occasion to use avertin per rectum with highly satisfactory results in patients who may be intolerant of local anæsthesia alone. The drug acts directly on the sleep center in the third ventricle.

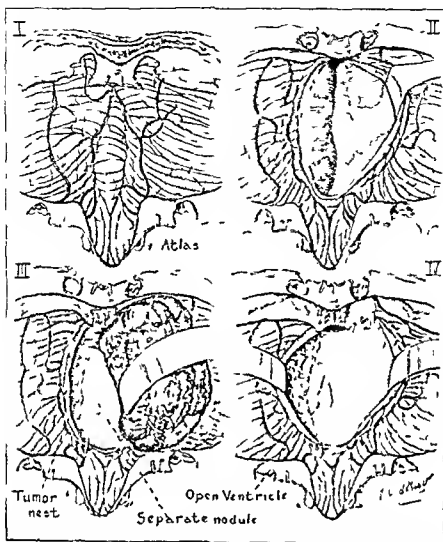


Fig 50 (Case 72) Operative sketches showing I the bulging vermis and marked pressure cone extending almost to the arch of the atlas II the lesion after primary exposure its right half cystic its left solid III the removal of the solid portion from its nest in left hemisphere without opening the ventricle disclosing small separate nodule IV the final appearance of the field with small opening into ventricle and sagging hemispheres (that on the right hanging by an anchoring vein) permitting full view of tentorium to margin of incision [Ref p 187]

The cerebellar exposure By good fortune as long ago as 1904 a satisfactory operative method had been hit upon of getting a wide bilateral exposure of the posterior face of the cerebellum. In one way or another this procedure has been simplified and perfected but in its essentials it remains as first described (14). As it is commonly referred to in the Table merely as the usual or customary procedure, something more may be said of it here,

for though "the operation proper" is represented by what is done after the cerebellum is once exposed, the method of approach and the method of withdrawal are essential parts of the procedure and may be exceedingly difficult and tedious.

It is, indeed, an adage of the operating room that "a cerebellar case takes an hour to get in, another to get out, and plenty of time between"—the "time between," usually a



Fig 51 (Case 72) The patient three weeks after operation [Ref p 187]

matter of an hour or two, may sometimes be extended to three or four. And should there have been sufficient uncertainty of localization to have made a preliminary ventriculography advisable—a measure we hesitate to resort to in critical cases such as these unless we are prepared to operate immediately afterward—this means pretty much a full day's work. Consequently to gain time for other things I have come of late years to relay most of these operations with my skillful associate, Gilbert Horrax, who does the larger part of the getting in and getting out while I take over the dealing with the lesion.

The postoperative photographs of the patients that accompany the few more detailed case reports that have been picked out for illustration will show the usual situation of the "cross bow" incision we continue to employ. It is not an operation for a tyro, and some neurosurgeons have recently advocated the return either to a vertical incision or to the old low, transverse incision, neither of which in my opinion gives adequate room for the critical manipulations to follow. The attempt to turn down a bone flap in this muscularly well protected region is wholly unnecessary and can only serve to incommode subsequent manipulations.

The linear part of the incision, which

should be precisely in the ligamentum nuchæ, is highly advantageous as one never knows when it may be necessary, owing to an extreme pressure cone or to an actual extension of the tumor through the foramen magnum, to laminectomize the atlas. This, as noted in the Table, was carried out in seventeen cases in the series and doubtless would have been beneficial in others (e g, Cases 4, 19 and 44), and in consideration of the fact that the

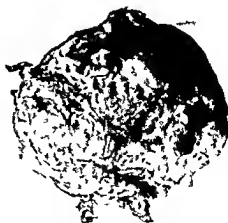


Fig 52 (Case 72) The attached surface of the tumor nodule after removal (nat size) [Ref p 188]

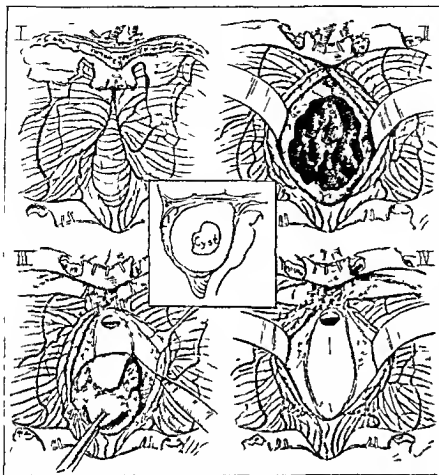


Fig. 53 (Case 73) Operative sketches showing I the bulging vermis and mild tonsillar herniation II the tumor after primary excavation III the residual fragment being withdrawn together with roof of ventricle IV, the resultant cavity with abundant clips shown above sagging hemispheres where vascular tentorial attachments had been torn [Ref p 188]

purpose of the laminectomy was to release a dangerous pressure cone it is significant that only two of these complicated operations led to a fatality. In Case 53, removal of the laminae of the axis as well as of the atlas, as will have been observed (Fig. 16), was necessarily carried out before the lower pole of the tumor could be liberated.

The curvilinear incision from mastoid to mastoid makes possible the wide reflection of the lateral flaps needed for the exploration of the lateral recesses when that is necessary, gives room for the "uncapping" of a hemisphere, when for the proper exposure of an awkwardly placed tumor this is called for, and permits sufficient lateral separation of the

hemispheres to give access to the deeper parts of the vermis without needless confusion.

Care should be taken in reflecting the curved flap of scalp downward to identify the margin of muscular attachment, a thin edge of which should be carefully preserved for subsequent suture in layers, for otherwise spurious meningoceles may form under the flaps. The repair of a wound in which this had occurred led to one of the fatalities in the series (cf. Case 54). The extracranial venous stasis produced by the intracranial tension, which inhalation narcosis serves to accentuate may not infrequently give serious trouble so soon as the muscle begins to be scraped from the bone in process of reflecting the lateral flaps. Waxing may fail to control

this and early recourse must sometimes be had to a ventricular puncture which greatly improves the situation by lowering tension. And with the needle left in position, excessive protrusion of the hemispheres, when the dura comes to be opened, is avoided and their subsequent manipulations are less likely to cause disagreeable symptoms. This device, first put into practice in 1909, has since become common property and it is but one of many similar steps so commonly employed as scarcely to deserve mention.

As a matter of fact, this preliminary emptying of the cerebral ventricle is disadvantageous in one respect for it may so lower tension in the posterior fossa that surface indications of

a deep, median, wholly subcortical tumor are effectually concealed and may be overlooked. This happened, as the Table records, at the first operation on Cases 4, 10, 11, 28, and 36, the last experience of the kind having been in September, 1923. The lesion in the succeeding forty cases, even though concealed, has (with the exception of Case 59) been brought to view and verified at the first session.

What is of chief importance, as emphasized in the section on gross pathology, is the close scrutiny of the widely exposed posterior surface of the cerebellum. There is of course no difficulty in locating the lesion when a portion of the tumor is visible on the surface, or when there is marked hemispheric asymmetry, or when palpation discloses a cyst. But when there is perfect symmetry as there often may be with a deep median, non-cystic lesion, the relative widening of the vermis is about all that one has to go upon. And should tension have been wholly relieved by escape of cerebrospinal fluid and the cerebellum have settled back into its normal position, it not only takes conviction to incise the vermis but one may have to carry the incision down a centimeter or two before the surface of the tumor, which may prove to be surprisingly large, is actually reached.¹

The surgical procedure is far more simple when there is a large cyst which bulges into one hemisphere more than the other, for even if not palpable its presence will often be betrayed by the hemispheric asymmetry and unmistakably widened convolutions. In earlier days, as the operative notes in the Table betray, we were led into making transverse incisions into these laterally placed cysts, but we have come more and more to feel that in



Fig 54 (Case 73) To show condition of patient when discharged on the eighteenth postoperative day [Ref p 188]

the majority of cases a vertical incision through the vermis is the preferential way of opening most of them if one is to attack the underlying mural tumor with the greatest promise of success.

The crux of the operation, as is now fully realized, lies in the removal of the mural nodule at the first operative session when its situation and the patient's condition makes the step permissible. These mural tumors are most variable in size and position. When superficially or laterally placed, they can be removed, even though of large size, with comparative ease from the wall of the cyst, at the base of which can usually be seen the flapping roof of the fourth ventricle a few millimeters in thickness. But when the mural tumor is in the depth and occupies the portion of the cyst wall corresponding to the ventricular roof, its removal is attended with much greater difficulty and hazard. Mural tumors that are situated in the midline bigly under the tentorium offer another particularly difficult problem for the reason that the vascular attachments from the posterior margin of the incisura to the leptomeninges are apt to be torn, and bleeding in this highly inaccessible region is exceedingly difficult to control (cf operative history of Case 73, p 188). A fatal

¹Apparently the first time this was done deliberately was on August 25 1922 Case 33

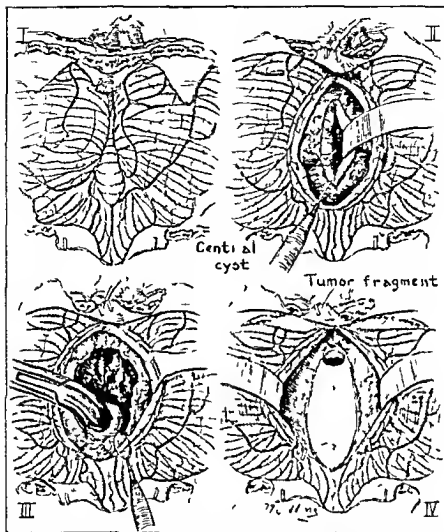


Fig 55 (Case 74) Operative sketches showing I, the exposed cerebellar field with slightly prominent uvula and moderate pressure cone II transsection of tumor after partial exposure III, method of piecemeal removal IV, final exposure with residual tag of coagulated tumor in dangerous region near incisure [Ref p 183]

occurred in Case 51, at a second operation after another highly favourable procedure, due to the postoperative formation of a clot from this source

But if these difficulties exist, after the evacuation of a large cyst has not only completely lowered tension but has provided ready access to the lesion, they are vastly increased when a solid central tumor is encountered. In dealing with these cases, the surgeon's judgment is put to the greatest test and whether or not a total extirpation should be attempted must depend on circumstances which relate

to the degree of vascularity of the growth and one's facility in controlling it, to its relative "suckability," to the evidence or otherwise that the growth is unattached to the ventricular floor, to the patient's general condition, and to many other factors

There are two particularly critical points of vascularity, the one at the calcaric region where branches of the posterior cerebellar arteries go to the choroid plexus of the region, the other at the aforementioned incisural margin of the tentorium. The operative sketches will possibly serve to

make some things more clear than the written word¹

It is important to complete the operation if possible at the first session. We were at one time encouraged to feel that a two stage procedure might be desirable and that the lesion might become extruded. This impression came about from the experience with Case 40 in which, during the repair of the muscle incision due to the formation of a pseudomeningocele, the cerebellar hemispheres were re-separated and a residual fragment of tumor, which was thought at the first session to be irremovable because of its position, was found almost wholly dislodged and it was picked out of the wound. But this is not likely often to happen. It was found impossible at the secondary operation under similar circumstances in Case 54 even to bring the residual fragment into view and the patient was lost from a streptococcus meningitis².

On other occasions (cf Case 49) I have left an operation incomplete after opening a large central cyst leaving, from lack of courage, a flat mural tumor on the roof of the ventricle in the hope that the subsequent accumulation of fluid would tend to push the growth outward. This is not what occurs under these circumstances. On the early re-exposure of a cerebellum after previous transsection of the vermis and evacuation of a large central cyst, it is difficult to believe that there has ever been a lesion present for the



Fig 56 (Case 74) Showing condition of wound on discharge [Ref p 189]

formerly separated hemispheres have folded themselves together and the widely exposed growth has become completely concealed.

Enough has been said in a previous article (17) regarding the usefulness of electro-surgery as an adjunct to intracranial operations. It may be re-emphasized after an interval of three years that it is now possible safely to eradicate many brain tumors that a few years ago would have been regarded as inoperable. Apparently the first case in the present series in which this surgical adjunct was put to effective use was in the handling of the tumor in Case 49 in its two sessions (Fig 41). In the treatment of a vascular brain tumor the intelligent use of a sucker, the employment of silver clips and the electro-surgical apparatus are (with the minor aid of muscle implantations and Zenker-wet cotton pledgets) in my estimation of about equal importance.

Postoperative therapy This may be briefly dismissed. Patients are routinely left with their position unchanged on the operating table with a provisional dressing applied until they have fully recovered from the immediate effects of the procedure. This is particularly important should it have been necessary to give an inhalation narcosis or should the patient be nauseated, for the face-down position is one in which there is the least risk of an

¹ It is customary for the surgeon to make sketches of the operative stages as he recollects them immediately at the conclusion of the procedures. No written description is of equal value, however crude the sketches. It is impossible for an artist to get near enough to the field with the patient in prone position for a direct view. The drawings accompanying the paper have been worked out by Miss Coddling from the originals on the hospital histories eked out in some of the more recent cases by her own fleeting glimpses of the field.

² This and another cerebellar case in a child (No. 54) in the medulloblastoma series both succumbed to a hemolytic streptococcal infection at a time when the community and the hospital staff were suffering from an epidemic of sore throats. They represent the only examples of infection in the series and were probably contaminated by the operator himself who though not ill was found to be harboring organisms in his throat. The masks then in use were found to be insufficient.

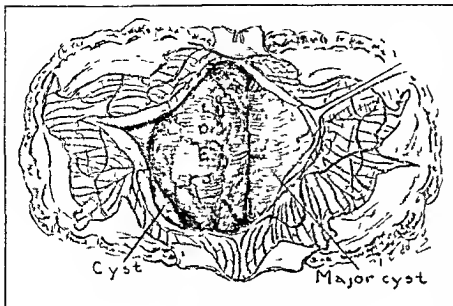


Fig. 57 (Case 75) Showing the general appearance at operation after exposure of a sausage shaped tumor capped by bilateral cyst [Ref p 189]

accident from vomiting. When conditions are critical and there is any impairment of respiration they may be kept in this position for twenty four hours or more and the instrument table is kept in readiness for immediate reopening of the wound should at any time there be a suspicion that a clot may have formed. The rectal temperature should be taken as soon as possible when the operation is concluded and frequently repeated in order that a tendency to hyperthermia should be promptly detected and measures for controlling it by antipyretic drugs or by sponging be applied.

These are the principal immediate precautions. Later complications in serious cases may require no less detail and we no longer venture to transfer critical cases of this sort to other than the expert care and undivided attention of a specially trained nurse. Deglutitory disturbance after wide exposure of the fourth ventricle may make feeding highly precarious and nasal feeding may sometimes be necessary for days. One feature of the convalescence of the patient, while the cerebrospinal fluid remains blood stained, is the periodic occurrence of waves of pyrexia which sometimes call for a succession of lumbar

punctures until the fluid has cleared. When punctures should be made and how much fluid can be safely removed takes experience and judgment. Attention to all these details is what in the long run greatly affects the operative mortality. The surgical procedure itself, important though it be, is by no means the whole story.

Mortality percent ages However brief the notes, the Table will show that many of the fatalities in the early years would to day have been avoid

able had we then known what we now know of the site, nature, and life history of these peculiar tumors. Even so, in consideration of the complicated nature of the operation and of the fact that from ignorance we were so often obliged because of return of symptoms to grapple with the always more difficult and hazardous secondary operations, the fourteen postoperative deaths for the 113 cerebellar operations on the 75 cases¹ is perhaps no more than one might justly expect.



Fig. 58 (Case 75) The cystic side of the mural tumor as removed at operation (nat size) [Ref p 189]

¹No cerebellar operation was undertaken on Case 6

This gives for these particular tumors a surgical case mortality of 18.6 per cent and an operative mortality at various hands of 12.4 per cent.

The effect of repeated operations on the operative mortality is shown by the fact that in the 75 primary explorations there were only six fatalities, namely, 8 per cent, whereas there were five fatalities out of 28 secondary operations (17 per cent), two fatalities in eight tertiary operations (25 per cent) and one of the two patients (Cases 7 and 22) that had four cerebellar operations succumbed as a result of the last of them which was a highly inadvisable undertaking.

The causes of death in the fourteen fatal cases have been respiratory failure in five instances (Cases 1, 21, 44, 47, and 68), hyperthermia in three (Cases 13, 22, and 41), meningitis in two (Cases 3 and 54), pneumonia (Case 33), postoperative clot (Case 51), perforative duodenal ulcer (Case 53), and the sudden unexplained death on the sixteenth day that occurred in Case 19. Could someone, profiting by the knowledge we now have slowly acquired regarding these tumors and the preferential way of treating them, have the opportunity of reoperating on precisely this same series of patients, the case mortality could well be held within 5 per cent, and secondary operations would be few and far between. An indication that this might be so is shown by the figures for the series of 23 successive cases admitted since January, 1928, there having been only one fatality, namely Case 68, with the large solid tumor of which so much has been made in preceding sections.¹

To give a better idea of the surgical problem and the way it has been met in these later-

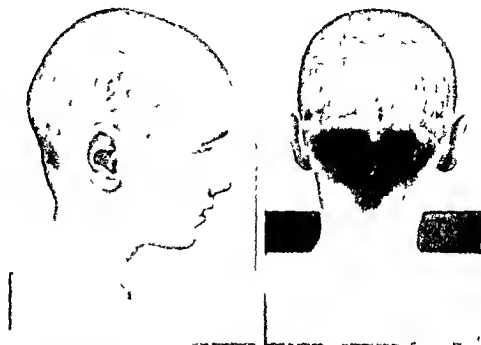


Fig 59 (Case 75) To show patient and condition of the wound at the time of discharge three weeks after operation [Ref p 189]

day patients, a brief report of the operative findings of the last few may properly be subjoined.

CASE 71. A neglected Polish child 10 years of age promptly referred by Dr E P Lothrop of Buffalo, gave a history of former matutinal head aches and vomiting which had ceased about seven months ago, of clumsiness at play for six months, of blurring of vision for five months, of double vision and extreme instability for three months, and of blindness for three weeks.

Examination showed a bedridden, hydrocephalic, blind child with a choked disc of 5 diopters and cerebellar ataxia so marked as to make tests for station or gait impossible. No nystagmus was observed beyond a few occasional ill sustained fine twitches. The deep reflexes were diminished with accompanying muscular hypotonicity. Shadows of slight calcification in the right cerebellar fossa were detected on the X ray films leading the roentgenologist to suspect a tuberculoma. The clinical diagnoses favoured astrocytoma over medulloblastoma.

The operation. This was conducted wholly under local anesthesia, the child behaving admirably throughout the four hour procedure. The usual cross bow incision with lateral reflection of flaps, puncture of lateral ventricle and removal of the suboccipital bone was completed without noteworthy incident. On opening the dura (cf Fig 47), a bulging vermis was disclosed with such marked tonsillar herniation an immediate laminectomy of the atlas was performed. The vermis was then electrically incised in the midline through the entire

¹ With the five cases that have been successfully operated upon with tumor enucleation since the tabular list was made up there would be a series of 28 consecutive operations with a single fatality giving a 3.6 per cent case mortality which is about what we should expect in the future.

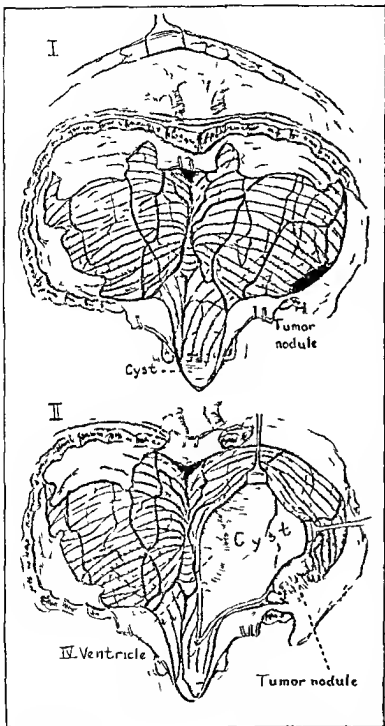


Fig 60 (Case 76) Operative sketches showing I the marked tonsillar herniation with cystic up on the right II, the opened cyst with bulging floor of fourth ventricle and laterally disposed tumor nodule [Ref p 190]

5 centimeters length of the exposure a greyish, soft partly median tumor being disclosed its lower portion palpably cystic A needle was inserted into the cyst and 30 cubic centimeters of promptly clotting clear xanthochromic fluid were withdrawn The large tumor which lay headward to this cyst was soft on palpation and suspecting another cyst a needle was introduced into it and 10 cubic centimeters of blackish blood-stained fluid were withdrawn without collapsing the growth

The tumor was easily separated from the cerebellar hemisphere on each side most of the dissection being made with the cutting needle No particular difficulties were encountered until the stage of freeing the upper surface of the tumor was reached There was little but a thin film of cortex and vascular lepto meninges separating the growth from the tentorium and this was soon torn into with troublesome bleeding from two or three good sized spurting vessels in the region of the incisura These were fortunately controlled by suction and caught with clips The branches from the posterior cerebellar arteries entering the growth at the region of the calamus having been secured earlier in the operation the remainder of the enucleation which necessitated removal of the ventricular roof together with the large growth was completed with the aid of electrical dissection as shown in the sketches, without undue difficulty The completely separated cerebellar hemispheres by this time were sagging from the tentorium with only a few points of vascular anchorage The huge cavity was filled with salt solution and after the usual toilette with painstaking hæmostasis the flaps were drawn together and closed in successive layers by rows of buried interrupted fine black silk sutures

Postoperative notes There was an early postoperative rise in temperature to 104°F but this promptly subsided on sponging On the following day 45 cubic centimeters of blood stained fluid were removed by lumbar puncture This was repeated on the third day, and as the temperature continued to range around 102° and the suboccipital region was somewhat full, on the sixth day the

site of the tumor was punctured and 110 cubic centimeters of bloody fluid not under tension were withdrawn. The patient meanwhile made excellent progress, she was walking fairly well at the end of two weeks and at the time of discharge (Fig 48) on the twentieth day the choked discs were flat and she was on the road to a complete symptomatic recovery in all respects except for the blindness.

The tumor. A fragment submitted to Dr Eisenhardt for examination so soon as the growth was exposed, showed a fibrillary growth with many small astrocytes, and it was in this case that isolated oligodendroglia cells were identified on the fresh smears. The subsequent sections confirmed the diagnosis of a moderately fibrillary astrocytoma and gave added information of spotty calcification. The tumor (Fig 49) was of large size and weighed with empty cyst 51.6 grams.

Though, in the next case, the growth (cyst included) was about the same size as the foregoing, its enucleation was facilitated by the fact that about half of the space-occupying lesion was cystic and the solid portion was fortunately unattached to the roof of the fourth ventricle.

CASE 72. A twelve-year old Italian school girl, referred by Dr F X Mahoney, of Boston gave a history of early morning headache and vomiting for a period of only three months, but the anamnesis records an attack of whooping cough three years previously during which she acquired a strabismus of the right eye that was subsequently corrected in part by an operation. For six months a faulty posture had been observed, for two months she had been growing awkward in her movements, for one month the gait had been staggering recently there had been blurring of vision.

The examination showed a frail child with manifest hydrocephalus, a choked disc of 6 diopters, a paresis of the right internal rectus, and an advanced cerebellar syndrome (in the absence of nystagmus) with marked hypotonicity of the musculature and slightly hyperactive deep reflexes.

Operation. This, a five-hour performance, was carried through wholly under local anesthesia after a preliminary 7 milligrams of morphia. The customary cerebellar exposure was made, the hydrocephalic left ventricle having been tapped in course



Fig 61 (Case 76) The patient two weeks after operation showing flat suboccipital region (Ref p 199)

The posterior cerebellar surface showed (Fig 50) a bulging vermis with greatly widened folia, its tip extending below the level of the foramen opening. There was a marked tonsillar pressure cone including the lower leaflets of the hemisphere necessitating a laminectomy of the atlas and dural incision to the arch of the axis before the cord was exposed.

The vermis was then split leaving bare the wall of a large cyst from which 60 cubic centimeters of quickly clotting xanthochromic fluid were withdrawn provoking an attack of vomiting. To the left of this cyst lay a hemispheric tumor extending from calamus up under the tentorium. It was electrically separated from its nest in the left cerebellar hemisphere and was removed by tilting it to the right, the usual difficulty being encountered (as in Case 71) in freeing the growth from its vascular attachments to the anterior tentorium, the posterior margin of the incisure being fully exposed.

Up to this point the roof of the fourth ventricle which was bulging into the deeper part of the cyst had not been opened. However an additional small tumor nodule was seen overlying the ventricle and in electrically excising this a small opening was made into the cavity. The separated cerebellar hemispheres by this time sagged markedly away from the tentorium, that on the right being hung by a single large anchoring vein. The great cavity was filled with salt solution and the wound was closed in the customary detailed way.

Postoperative course. This was without incident. There was a febrile reaction to 102° F which slowly subsided. No punctures were called for. The choked disc slowly subsided without impairment of vision. She was discharged (Fig 51) at the end of a month.

walking fairly well and when examined six weeks later had become essentially symptom free.

The tumor. The nature of the growth was apparent at operation and the supravital study confirmed the diagnosis. Subsequent sections taken from the mural tumor (Fig. 52) showed a typical densely fibrillary astrocytoma with characteristic hyalinization of the blood vessels (cf Fig. 45).

The next case presented a surgical problem similar to that of Case 71 but there was no superficial cyst to facilitate the extirpation and the tumor was removed piece meal in the hope of avoiding the risks of hemorrhage from tearing the high tentorial veins of anchorage, an object not attained.

CASE 73. A twelve year-old school boy referred by Dr Maurice Brien of Lewiston Maine gave a ten months history of occasional attacks of morning vomiting and occipital headache following a fall on the head. For one month he had had periodic dizziness diplopia tinnitus and stiffness of the neck. He had recently found some difficulty in balancing on his bicycle. He had been at school until three weeks before admission.

Examination showed a healthy appearing lad with a rather large head giving a MacEwen's sign on percussion a choked disc of 4 diopters with beginning atrophy slight occasional nystagmus a positive Romberg and some instability in gait. The degree of inco-ordination was slight.

The operation. This was conducted wholly under novocain without preliminary drugs. The exposure of the cerebellum (Fig. 53) was made without undue difficulty, the hydrocephalic ventricle having been punctured in course. The vermis was widened and there was a pressure cone but the tonsils could be withdrawn after opening the posterior cistern without the need of an atloid laminectomy. The wholly concealed greyish tough tumor was brought to view by the usual median incision. The growth after partial electrical separation from the hemispheres proved to be fully as large as that shown in Figure 49. In the process of attempting to enucleate it the tentorium soon became exposed and fearful of getting bleeding from the anchoring veins a piece meal excavation of the lesion was begun. A cyst of considerable size was encountered in the center of the growth and this facilitated the procedure.

Everything went well until at the last moment of separating the tumor's anterior pole an anchoring vein must have been torn and blood began to appear in the subdural space around the hemispheres. A coincidental attack of vomiting complicated the situation but I managed to get the bleeding checked by pressure of a cotton pledget inserted between the tentorium and leptomeninges while the rest of the upper pole of the growth was quickly removed by rongeurs and suction. On then removing the pledget serious bleeding started afresh and the blood pres-

sure dropped off markedly before bleeding was again temporarily controlled by another implanted pledget. Preparations were made for a transfusion and muscle for implantation was taken from the patient's gastrocnemius. Strips of muscle were then worked in between the tentorium and the pledget until it could be removed. It was a close call.

The patient meanwhile had been given 250 cubic centimeters of blood from a donor. It was finally possible to attack the remaining and lower portion of the growth and to draw it downward, the lateral margins of the ventricular roof which came with it being electrically divided. The wound was then closed with the usual detail. The boy behaved superbly throughout the long five and a half hour procedure.

Postoperative course. Apprehending a possible complication from a postoperative clot the patient was not removed from the operating table for several hours. Convalescence as a matter of fact was surprisingly uneventful. There was an early rise in temperature to 103° which promptly subsided. The dressing was done on the fifth day when a lumbar puncture was made withdrawing 60 cubic centimeters of xanthochromic fluid. This was repeated three days later. The choked discs had subsided by the tenth day leaving vision somewhat impaired in one eye only. He was discharged on the twenty third day (Fig. 54) practically symptom free.

The surgical difficulties encountered in the operation described above were reflected in the more conservative way in which a month later the lesion in the next case—another non-cystic median tumor of the same type and size—was treated.

CASE 74. An eleven year-old school boy from a country district was referred by Dr I. G. Jones of Utica New York as an urgent case because of failing vision. There had been a history of occasional headaches and vomiting extending over a period of more than two years. For one year there had been periods of blurred sight and occasional attacks of (cerebellar?) unconsciousness. For three months the gait had been unsteady.

The examination showed evident secondary hydrocephalus choked discs of 3 diopters with beginning secondary atrophy. There was unsteadiness of station and gait but the cerebellar signs were not marked. A well sustained nystagmus was present. The long history made the diagnosis of an astrocytoma probable.

The operation. This a five hour procedure was performed wholly under local anesthesia with a preliminary dose of 0.8 milligrams of morphia. The cerebellar exposure (Fig. 55) was difficult owing to the huge emissary vessels communicating with the bone and scalp in the torcular region necessitating an early puncture of the ventricle, the fluid being found under great tension. This however did not

serve greatly to lower subtentorial tension for the cerebellum protruded on opening the dura. The vermis was not particularly prominent but on electrically incising it to a depth of possibly 4 millimeters, the smooth greyish surface of an unmistakable astrocytoma was brought to view.

After this tumor had been more fully exposed it was electrically transected, a central, *circa* 20 cubic centimeter cyst (as in Case 73) being encountered the tension of the tumor being definitely lowered by its evacuation. The tumor proved to be of such large size that it was deemed inexpedient with what was rather an inadequate exposure to attempt its removal intact. Masses of the growth were then picked up with rongeurs and cut off with the cutting loop. This was followed by suction and scalloping until the size of the growth was so reduced it could be drawn away from the roof of the ventricle which was fully opened by the electric needle as the final mass was removed. From the region of the incision above the greatly dilated iter there hung a fringe of tissue that looked suspiciously like residual tumor. Fearing that its dislodgment might lead to serious bleeding, this spot was thoroughly coagulated with the spraying current. At this stage the operation was concluded and closure begun. The long operation was exceedingly well borne with practically no change in pulse or blood pressure from beginning to end.

Postoperative course. The threat of hyperthermia, namely a prompt rise in temperature to 104° , was overcome. Lumbar punctures were made on the second day when 30 cubic centimeters and on the third day when 50 cubic centimeters of blood stained fluid were withdrawn. Nasal feeding was instituted during the first week owing to deglutitory difficulties. The choked discs subsided fortunately with retention of useful vision. The wound was well healed without tension and the boy was discharged in excellent condition on the twenty eighth day after operation (Fig 56). On last reports, he is at school and symptom free.

The tumor was an astrocytoma of predominantly fibrillary type.

In the next case operated upon by Dr Horrax a hemi cystic lesion very similar to that in Case 72 (cf Fig 50) was encountered and its solid portion was removed.

CASE 75. A six year-old child referred to the hospital by Dr Charles A. Sparrow of Worcester, Massachusetts, had been considered delicate since the age of four following an attack of whooping cough. She had had occasional attacks of vomiting and had complained of stiffness of the neck. An alarming symptom however had occurred until six weeks before admission when impairment of sight was observed and for one week she had been blind.

Examination showed the familiar signs of hydrocephalus, a marked secondary optic atrophy without measurable choking, amaurosis and inco-

ordination of ocular movements, a stiff neck with suboccipital tenderness, and a moderate degree of ataxia of all extremities with sluggish deep reflexes.

The operation. Owing to lack of co-operation, the five and a half hour procedure was conducted under avertin ether anesthesia. The suboccipital bone was thin and easily removed. An early puncture of the ventricle disclosed a high degree of hydrocephalus under marked tension. The exposed cerebellar hemispheres (Fig 57) had the typical appearance of a median bulging cyst which was electrically opened by a vertical incision. To the left of the cystic cavity was a sausage shaped mural tumor, the better to expose which a transverse incision was made over the left hemisphere. The cross cut opened another superficial cyst to the left of the lesion. The growth was easily freed by electrical dissection and removed intact without opening into the fourth ventricle. The vessels at its anterior pole could be seen and clipped before the growth was detached from this critical point. The cavity was filled, as customary, with salt solution and the wound closed.

The tumor (Fig 58) proved to be a densely fibrillary astrocytoma of the type shown in Figure 37.

Postoperative course. The usual early postoperative rise in temperature (103° F) occurred, and, in spite of a succession of five lumbar punctures, the temperature did not fall to normal till the tenth day. Apart from the blindness the child (Fig 59) was in excellent condition and essentially free from ataxia at the time of discharge.

The last case included in the Table was an older patient who had a predominantly cystic and well lateralized lesion which at the time of operation was mistaken for a probable angioblastoma.

CASE 76. A farmer aged 21 was referred by Dr S. C. Cates of East Vassalboro, Maine, owing to rapidly failing vision. The patient obscurely dated his symptoms from a supposed sunstroke two years previously since when he had been subject to "giddy spells." Six months later his sight began to be affected and he became aware of stiffness of the neck and unsteadiness of gait. He insisted that he had never had headache or vomiting and that there had been no change to speak of in his symptoms for a year.

Examination showed moderate hydrocephalus (on X-ray films), extreme suboccipital tenderness, a bilateral secondary (?) optic atrophy with pallor of the discs but no oedema, vision being reduced to counting fingers. There was marked nystagmus, and extreme cerebellar incoordination pointing to a lesion of the right cerebellar hemisphere. An indefinite caloric response to irrigation in the right ear and an apparent erosion of the mesial end of the right petrous ridge shown on the X-ray suggested a possible acoustic tumor.

The operation. Difficulties were encountered from the outset due to huge emissary venous channels in

the bone and scalp necessitating early puncture of the lateral ventricle (Fig 60). The suboccipital bone was thin and papery well down to the foramen magnum. On opening the dura an extreme pressure came chiefly of the right tonsil was brought to view. After laminectomizing the atlas the dural incision was carried down to the axis before the herniated tonsil whose tip was cystic could be liberated. The right hemisphere palpably contained a huge cyst and in the lower part of the field was a dark coloured, superficially placed reddish tumor nodule so near the surface as almost to suggest an extracerebellar lesion. An electrical incision was made from the distended tonsil upward and across the widened convolutions of the right hemisphere exposing the wall of a huge cyst containing promptly clotting canary coloured fluid. The cyst extended across the midline into the left hemisphere and at its base the bulging membrane constituting the roof of the fourth ventricle could be seen. The superficial tumor nodule which was slightly adherent to the dura was electrically excised. It proved to be a highly vascular fibrillary astrocytoma.

Postoperative course. From this simple operation as might be expected the patient made a prompt and satisfactory recovery (Fig 61) with rapid subsidence of his cerebellar symptomatology and, curiously enough, with definite improvement in vision.

Thus, of these last six cases which represent some of the surgical problems likely to be encountered when the effort is made to eradicate the tumor at the primary operation, three have been essentially solid lesions, two have been associated with external cysts of about half the size of the lesion, and the last was a predominantly cystic astrocytoma which had become projected into a lateral hemisphere.

12 SUMMARY

The cerebellar astrocytomata furnish another example of gliomatous tumors which, like the medulloblastomas, show predilection for a favourite site and produce a recognizable syndrome. The tumors are probably of congenital origin and usually date symptomatically from childhood, the average age on admission being 13 years. They are signalized by periodic matutinal headache and vomiting.

Owing to their mid cerebellar situation, the tumors inevitably cause secondary hydrocephalus and this, in turn, leads to a choked disc which may be so insidious in origin that seriously impaired vision may be the first recorded symptom. They may attain a surprisingly large size before any cerebellar signs,

usually shown as instability, put in an appearance.

The tumors may be either compact growths or be largely cystic. When predominantly cystic, recurrence of symptoms is inevitable unless the mural nodule of tumor is identified and removed at the time of operation. To establish this apparently simple fact has required years of observation of cystic lesions variously treated.

The clinical diagnosis lies between astrocytoma and other forms of tumor that frequent the same region, medulloblastoma, angioblastoma and ependymoma, of which the astrocytomata are the most numerous.

The growth is composed of fibrillary and protoplasmic astrocytes in varying proportions and is therefore a mixed tumor, being firm or soft in texture in accordance with the predominating type of cell. An immediate diagnosis of the cytological characteristics of the lesion can be determined in case of doubt by employing the supravital technique.

The tumors may lie exposed on the surface or be wholly concealed, and when so concealed, a vertical incision through the vermis is the proper method of bringing them to view. The operation which can usually be carried out under local anaesthesia should, if possible, be completed at the first session, a complete eradication of the growth at a second session being far more hazardous.

The 18 per cent case mortality for the series of 76 cases is largely ascribable to inexperience and to fatalities from secondary operations. With better understanding of the nature and favoured site of the lesions in the last 25 consecutive operations there has been a case mortality of only 4 per cent in spite of the prolonged and radical operations now undertaken by modern methods with attempted cure at a single session.

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NOTE.—There is appended the table of cases on which this study has been based

TABLE OF CASES

| Serial No. | Ho pital No name and date | Sex age | Duration (months) | Inaugural symptoms | Operative procedures | | Contemporary pathological diagnosis | | Survival period from reoperation | Previous references and comments | |
|---------------------------------|---------------------------------------------------------------------------------------------------------------|----------------|-------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------|----------------------------------|--|
| | | | | | Pre operative | Operative | II histological | | | | |
| JOHN S. HOPKINS HOSPITAL SERIES | | | | | | | | | | | |
| 1 | 22041 Sawley Feb 24 1908 Readmission Apr 19 1909 | F 23 mo | 12 | Ad. anisocoria cephalus | I Feb 30 1908 Combined lumbar and ventricular puncture II Mar 11 1908 Combined lumbar and ventricular puncture III Apr 20 1909 Suboccipital exploration. Excision of huge medulla, largely occupying right hemispherical lateral femoral cist wall | Hydrocephalus Cerebellar tumor (?) | Autopsy (Figs 2 & 3) Gliomatous cyst (top) & hydrocephalus (bottom) (Fig 2) partially fibrillary (top) (Fig 3) | Postoperative fatality (3 hours) | Cited as pilocytic astrocytoma with photo. B & C (7 1926 p 149) | | |
| 2 | 1886 Pierri Apr 2 1909 | M 26 yrs | 4 | Unsteadiness advanced to impaired vision with periodic amblyopia | I Feb 1 1909 Osteoplastic exploration of left cerebral hemisphere with outdissection on performed in Brooklyn II Apr 14 1909 Ethoid Bilateral cerebellar exploration. Large meningeal lateral cyst dissected out together with mural nodule | ? | Cystic glioma with mural nodule (top) moderately fibrillary (bottom) (Fig 3) | Perfect recovery apart from impaired vision. Support family as bookmaker (Aug 28 1910) | Reported M (4-1911) Case 1 Cl B & C (7-1926 p 150) | | |
| 3 | 1968 Hawley May 20 1910 Admission to Boston Hosp Aug 17 1911 Admission to Brigham Hosp Dec 8 1913 | F 26 yrs | 13 | Headaches increased to violent bilaterally Return of symptoms Return of symptoms | I May 21 1910 Customary cerebellar exploration. No definite tumor. Excision of lateral ventricle in course. Extensive deep median cerebellar cyst removed (Fig 1) II Aug 3 1911 Reoperation (recurrence of symptoms) (Dr E. H. Nichols location) Partial removal of large gliomatous tumor III Dec 13 1913 Extirpation of recurrent gliomatous mass filling cyst. Exposure of fourth ventricle | Cerebellar tumor ? Recurrent glioma | Cerebellar tumor (Fig 1) ? Glioma with abundant fibrillar formation. As trophic invasion. As trophic invasion (Fig 2) moderate fibrillary (Fig 3) | Freedom from symptoms apart from loss of vision for 12 months Freedom from symptoms apart from glioma for 20 months Fatality from wound infection and meningitis 5th day | Cl B & C (7 1926 p 150) | | |
| 4 | 2689 Cunningham Oct 31 1910 Readmission Jan 8 1912 Admission to Brigham Hosp Jan 16 1914 | M 30 yrs | 5 yrs | Unsteadiness advanced to blindness Recurrent Headaches and vomiting Highly advanced symptoms. Cerebral riddens. Cerebral hemorrhages. Paralysis | I Nov 5 1910. Ethoid Suboccipital exploration marked pressure. No surface tumor. Punctures negative II Jan 10 1912 Ethoid Recurrence of tumor. Partial dissection of cyst wall III Jan 20 1914 Ethoid Recurrence of tumor. Dissection of large median tumor occupying cerebellum and projecting into spinal canal. Incomplete extirpation of growth | Cerebellar tumor Cerebellar tumor Recurrent glioma | Glioma fibrillated with hyaline degeneration (Fig 1) As pilocytic astrocytoma, probably (Fig 2) recurrence of tumor through out (Fig 3) | Considerable relief for 2 months apart from loss of sight up and about Temporary freedom from dissection in after 2 months (Fig 3) Postoperative fatality 20 hours after operation (Fig 4) As pilocytic astrocytoma, probably (Fig 4) recurrence of tumor through out (Fig 5) | Reported with photo. as pilocytic astrocytoma (B & C (7 1926 p 150) | | |

| No. | Sex | Age | Date | History | Findings | Diagnosis | Treatment | Outcome | Remarks | Reported length of survival |
|-----|-----|-----|------|----------------------------------------------------------|--------------------------------------------------------------------------|---------------------|-------------------------------------------------------|--------------------------------------------|-------------------------------------------------------------------|-----------------------------|
| 5 | M | 27 | 1911 | Unsteady gait, vomiting, weakness of respiratory failure | Small right-sided cerebellar decompression (1) performed in 1911 (Chase) | Cerebellar cyst (?) | Operation without puncture for hydrocephalus negative | Death 8th day without cerebellar operation | Reported length of survival with long survival (Chase) 1916 p 150 | |
| 6 | M | 31 | 1912 | Sudden return of symptoms after 13 year interval | Headache and vomiting, cerebellar tremors | Cerebellar tumor | Operation without puncture for hydrocephalus negative | Death 8th day without cerebellar operation | Reported length of survival with long survival (Chase) 1916 p 150 | |
| 7 | F | 4 | 1912 | Headache, vomiting, weakness of respiratory failure | Headache, vomiting, weakness of respiratory failure | Cerebellar tumor | Operation without puncture for hydrocephalus negative | Death 8th day without cerebellar operation | Reported length of survival with long survival (Chase) 1916 p 150 | |
| 8 | M | 31 | 1912 | Headache, vomiting, weakness of respiratory failure | Headache, vomiting, weakness of respiratory failure | Cerebellar tumor | Operation without puncture for hydrocephalus negative | Death 8th day without cerebellar operation | Reported length of survival with long survival (Chase) 1916 p 150 | |
| 9 | M | 31 | 1912 | Headache, vomiting, weakness of respiratory failure | Headache, vomiting, weakness of respiratory failure | Cerebellar tumor | Operation without puncture for hydrocephalus negative | Death 8th day without cerebellar operation | Reported length of survival with long survival (Chase) 1916 p 150 | |
| 10 | M | 31 | 1912 | Headache, vomiting, weakness of respiratory failure | Headache, vomiting, weakness of respiratory failure | Cerebellar tumor | Operation without puncture for hydrocephalus negative | Death 8th day without cerebellar operation | Reported length of survival with long survival (Chase) 1916 p 150 | |

PETER BRYAN BRIDGMAN HOSPITAL SERIES

| No. | Sex | Age | Date | History | Findings | Diagnosis | Treatment | Outcome | Remarks | Reported length of survival |
|-----|-----|-----|------|-----------------------------------------------------|-----------------------------------------------------|------------------|-------------------------------------------------------|--------------------------------------------|-------------------------------------------------------------------|-----------------------------|
| 11 | F | 4 | 1912 | Headache, vomiting, weakness of respiratory failure | Headache, vomiting, weakness of respiratory failure | Cerebellar tumor | Operation without puncture for hydrocephalus negative | Death 8th day without cerebellar operation | Reported length of survival with long survival (Chase) 1916 p 150 | |
| 12 | F | 4 | 1912 | Headache, vomiting, weakness of respiratory failure | Headache, vomiting, weakness of respiratory failure | Cerebellar tumor | Operation without puncture for hydrocephalus negative | Death 8th day without cerebellar operation | Reported length of survival with long survival (Chase) 1916 p 150 | |
| 13 | F | 4 | 1912 | Headache, vomiting, weakness of respiratory failure | Headache, vomiting, weakness of respiratory failure | Cerebellar tumor | Operation without puncture for hydrocephalus negative | Death 8th day without cerebellar operation | Reported length of survival with long survival (Chase) 1916 p 150 | |
| 14 | F | 4 | 1912 | Headache, vomiting, weakness of respiratory failure | Headache, vomiting, weakness of respiratory failure | Cerebellar tumor | Operation without puncture for hydrocephalus negative | Death 8th day without cerebellar operation | Reported length of survival with long survival (Chase) 1916 p 150 | |
| 15 | F | 4 | 1912 | Headache, vomiting, weakness of respiratory failure | Headache, vomiting, weakness of respiratory failure | Cerebellar tumor | Operation without puncture for hydrocephalus negative | Death 8th day without cerebellar operation | Reported length of survival with long survival (Chase) 1916 p 150 | |
| 16 | F | 4 | 1912 | Headache, vomiting, weakness of respiratory failure | Headache, vomiting, weakness of respiratory failure | Cerebellar tumor | Operation without puncture for hydrocephalus negative | Death 8th day without cerebellar operation | Reported length of survival with long survival (Chase) 1916 p 150 | |
| 17 | F | 4 | 1912 | Headache, vomiting, weakness of respiratory failure | Headache, vomiting, weakness of respiratory failure | Cerebellar tumor | Operation without puncture for hydrocephalus negative | Death 8th day without cerebellar operation | Reported length of survival with long survival (Chase) 1916 p 150 | |
| 18 | F | 4 | 1912 | Headache, vomiting, weakness of respiratory failure | Headache, vomiting, weakness of respiratory failure | Cerebellar tumor | Operation without puncture for hydrocephalus negative | Death 8th day without cerebellar operation | Reported length of survival with long survival (Chase) 1916 p 150 | |
| 19 | F | 4 | 1912 | Headache, vomiting, weakness of respiratory failure | Headache, vomiting, weakness of respiratory failure | Cerebellar tumor | Operation without puncture for hydrocephalus negative | Death 8th day without cerebellar operation | Reported length of survival with long survival (Chase) 1916 p 150 | |
| 20 | F | 4 | 1912 | Headache, vomiting, weakness of respiratory failure | Headache, vomiting, weakness of respiratory failure | Cerebellar tumor | Operation without puncture for hydrocephalus negative | Death 8th day without cerebellar operation | Reported length of survival with long survival (Chase) 1916 p 150 | |

TABLE OF CASES

PETER BENT BRIGMAN HOSPITAL SERIES—Continued

| Serial No. | Hospital No. name and date | Sex age | Duration (months) | Inaugural symptoms signs | Operative procedures | Contemporary pathological diagnoses | | | Convalescent notes Result to last report | Survival period from first operation | Previous references and comments |
|------------|---------------------------------|----------|-------------------|------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------|---------------------------------|---------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------|--------------------------------------|
| | | | | | | Pre-operative | Operative | Histological | | | |
| 11 | 6509 Halsey Aug 17 1914 | M 38 yrs | 3 yrs | Suboccipital pain on lying with staggering with cerebellar seizures | I Aug 24 1914 Subtemporal decompression as palliative measure II Sept 3 1914 Suboccipital exploratory incision with bilateral parietal craniectomies negative cerebellar tumor III Mar 6 1915 Suboccipital resection Evacuation 200 c cm tan chocolate cyst. Formalin fixation | Cerebellar tumor (7) of left hemisphere (P) Left cerebellar tumor | Glioma tumor with cyst | Wall of gliomatous cyst gliosis (1915) Astrocytoma fibrillary (1916) sparsely fibrillary (1930) | Amelioration of symptoms | Survived 15 years | Mural growth in suboccipital removed |
| 12 | 4024 Jasper Dec. 17 1915 | M 23 yrs | 18 yrs | Occipital head Advanced to last vision | Dec 23 1915 Either Suboccipital exploration-laminectomy either large multilocular median tumor lateral resection Operation refused | Median glioma with cerebellar tumor | Cystic glioma, fourth ventricle | Cystic glioma, fibrillary (1915) Astrocytoma fibrillary (1916) densely fibrillary (1930) | Amelioration of symptoms for 6 months | Survived 17 months | |
| 13 | 3554 Barnett Oct 6 1916 | F 17 yrs | 2 yrs | Headache and constipation Moderate | Oct 10 1916 Either Suboccipital exploration large partly cystic multilocular tumor with large egg Procedure incomplete | Cerebellar tumor | Median glioma fourth ventricle | Glioma (1916) Astrocytoma fibrillary (1916) tissue mass (1930) | Fatally hyperthermia (34 hours) Autopsy | Postoperative fatality | |
| 14 | 3112 Barnett July 21 1916 | M 34 yrs | 7 yrs | Stiff neck and blurred vision Advanced syn drome near blindness Recurrence Bredt's Blind | I Aug 6 1916 Either Local bilateral exploration. Ventricular puncture McLean cyst opened by incision with hemispheres Partial excision of cyst wall Formalin fixation Either Re-exploration II Jan 19 1917 Large solid tumor mass left hemisphere with 30 c cm cyst in right Tumor removed | Cerebellar cyst | Median glioma | Cyst wall no tumor Cystic glioma (1930) Astrocytoma fibrillary (1930) chondroblastoma with rare fibrillated (1930) | Stormy convalescence hyperthermia lumbar puncture Ultimate good recovery Living and well in institution I + blind light perception non only Sept 9 1930 | Living 14 years | |
| 15 | 6150 Gibson Jan 26 1917 | F 20 yrs | 12 yrs | Headache vom iting blurred vision low eye trauma Admitted to hospital blind does not see | Feb 1 1917 Either Suboccipital exploration Large median cyst with mural tumor at base of lateral ventricle in through transverse cerebellar incision. Zeller's fixation No operation owing to intercurrent measles | Cerebellar tumor | Microcystic glioma | Glioma fibrillary (1917) Astrocytoma fibrillary (1920) moderately and coarsely fibrillary (1930) | Excellent result for 6 years despite blindness and some neglect | Survived 6 1/2 years | CI photo D & C (7 1916 p 13) |
| | Readmission Aug 15 1923 | | 6 | Recurrence altered vision blurred vision | | | | | Sudden death retina 1 retina hure Oct. 1 1923 Autopsy large w. 1 1/2 gms one fourth v nodule | | |

| No. | Date | Age | Sex | Symptoms | Operation | Cerebellar tumor | Median cystic glioma | Glioma, partly calcified (1919) Astrocytoma (1920) Meningeal cyst (1921) Saccular fibrous (1920) | Prompt improvement | Living | Mural growth inactive, partially removed |
|-----|-----------------------------------|-------|-----|--------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------|---------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------|----------------------------------------------------|
| | | | | | | | | | | | |
| 16 | 1883 Mayer July 23 1919 | 3 yrs | F | Headache and vomiting F. H. syndrome advanced to near blindness | July 23 1919 Either Usual suboccipital exploration or Ventricular puncture Nodule of cystic tumor presenting at calamus Total extirpation | Cerebellar tumor | Median cystic glioma | Glioma, partly calcified (1919) Astrocytoma (1920) Meningeal cyst (1921) Saccular fibrous (1920) | Prompt improvement Retention 20,200 vi toms to date (Sept 1920) Summing lanc ing etc. Earning living as clerk | Living 17 years | Mural growth inactive, partially removed |
| 17 | 1883 Peters Sept 19 1919 | 4 yrs | F | Headache and vomiting F. H. syndrome Advanced to blindness | I Sept 26 1919 Either Suboccipital exploration or Ventricular puncture Latter partially removed Zucker fraction | Cerebellar tumor | Glioma cystic right hemisphere sphere | Extensive and fibrous lary glioma (1919) Astrocytoma (1920) lary (1920) parasy fibrous with exten sive protoplasmic areas (1920) | Complete relief from Symptoms except for blindness for 7 1/2 years | Living 17 years | Presenting tumor cap removed |
| 18 | 1884 Williamson Oct 23 1919 | 5 yrs | M | Headache, vomiting double vision Moderately advanced | I Oct 27 1919 Either Suboccipital exploration or Intracranial deep ventricular puncture Chronic cystic glioma removed only (1/2 of large tumor mass removed) | Right cerebellar tumor | Glioma cystic | Anterior and fibrous lary glioma (1919) Astrocytoma (1920) lary (1920) parasy fibrous with exten sive protoplasmic areas (1920) | Complete freedom from Symptoms 3 years 4 months | Living 17 years | Subsequent reoperation therapy |
| 19 | 1885 Foster Nov 17 1919 | 5 yrs | M | Headache and vomiting F. H. syndrome Advanced to blindness | Dec 6 1919 Either Usual suboccipital exploration or Intracranial deep ventricular puncture Latter partially removed Membranous roof fourth ventricle at base of cavity intact | Cerebellar tumor | Median cystic glioma | Glioma, partly calcified (1919) Astrocytoma (1920) Meningeal cyst (1921) Saccular fibrous (1920) | Perfect recovery to Aug 6 1920 | Living 17 years | Subsequent reoperation therapy |
| 20 | 1886 Hugges April 12 1920 | 6 yrs | M | Headache and vomiting F. H. syndrome Advanced to blindness | April 20 1920 Either Usual exploration or Disclosure posterior pole of tumor Removed for examination | Cerebellar tumor | Median cystic glioma | Glioma, partly calcified (1919) Astrocytoma (1920) Meningeal cyst (1921) Saccular fibrous (1920) | Satisfactory recovery but return of symptoms 3 1/2 months and death 5 months No autopsy | Survived 5 months | First observed calamus nod ule Vermis not split |
| 21 | 1887 McCue Oct 3 1920 | 7 yrs | M | Blurring vision Instability Moderately advanced F. H. syndrome Advanced to blindness | I Oct 16 1920 Either Suboccipital exploration or Ventricular puncture Latter partially removed Zucker fraction | Right cerebellar tumor | Median cystic glioma | Glioma, partly calcified (1919) Astrocytoma (1920) Meningeal cyst (1921) Saccular fibrous (1920) | Only brief improvement in symptoms | Survived 8 months to 10 months fatal | First observed calamus nod ule Vermis not split |

TABLE OF CASES

DEAR WEST BEICHAM HOSPITAL STAFFS—Continued

[illegible]

| No. | Age | Sex | Date | Symptoms | Operation | Pathology | Post-operative course | Complete freedom from symptoms for 1 year | Roentgen therapy supported by beneficial |
|-----|--------|-----|------|----------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------|---------------------------------------------------------------------------------------------------|-------------------------------------------|------------------------------------------|
| | | | | | | | | | |
| 26 | 15 yrs | F | 1935 | Headache and vomiting following trauma | I Oct 19 1935. Exploratory. Evacuation tumor fixed cyst (2.5 cm) right hemisphere. Partial removal. Zeller's operation. | Cystic cerebellar tumor | Relief for 6 months | Complete freedom from symptoms for 1 year | Roentgen therapy supported by beneficial |
| | | | | Well developed syndrome | II Jan 8 1935. Re-exploration (Dr Ernest Sachs St. Louis). Evacuation 60 c cm cyst with partial removal. | Cystic glioma | Relief for 2 weeks | Living 9 years | |
| | | | | Recurrence | III Sept 17 1935. Puncture (Dr Sachs) of recurrent cyst (7.0 c cm) (Dr Sachs) with removal of solid laterally placed mural tumor of hemisphaera. | Recurrent cyst | Complete subsidence of symptoms. Perfect recovery to date (Sept. 2 1936) | | |
| | | | | Recurrence | IV Oct 22 1935. Re-exploration (Dr Sachs) with removal of solid laterally placed mural tumor of hemisphaera. | Recurrent cyst | Symptom free for 6 months only | | Roentgen therapy V/D (x 19 8 Case 46) |
| 27 | 15 yrs | F | 1935 | Morning vomiting | I Nov 8 1935. Exploratory. Evacuation deep cerebellar cyst (40 c cm). Transverse incision right hemisphere. No tumor nodule noted. | Multicystic cerebellar tumor | Symptom free for 6 months only | Living 8 1/2 years | |
| | | | | Well developed syndrome | II Sept 21 1935. Fiber Re-exploration (Horax). Re-exploration 60 c cm cyst. | Cerebellar cyst (ditto) | Complete subsidence of symptoms. Perfect recovery to date (Aug 22 1936) | | |
| | | | | Recurrence | III July 31 1935. Fiber Re-exploration (Horax). Re-exploration 90 c cm cyst overlying fourth ventricle in normal fashion. Presenting thick wall of cyst removed. | Cerebellar cyst (ditto) | Symptom free for 6 months only | | |
| | | | | Recurrence | IV Nov 13 1935. Fiber Re-exploration (Horax). Re-exploration 90 c cm cyst overlying fourth ventricle in normal fashion. Presenting thick wall of cyst removed. | Cerebellar cyst (ditto) | Complete subsidence of symptoms. Perfect recovery to date (Aug 22 1936) | | |
| 28 | 15 yrs | M | 1935 | Temporary paralysis | I Nov 13 1935. Exploratory. Evacuation deep cerebellar cyst (40 c cm). Transverse incision right hemisphere. No tumor nodule noted. | Cerebellar tumor | Good recovery. Subsequent complete subsidence of symptoms. Perfect recovery to date (Aug 22 1936) | | Roentgen therapy V/D (x 19 8 Case 47) |
| | | | | Headache and vomiting | II Nov 29 1935. Fiber Re-exploration (Horax). Re-exploration 90 c cm cyst overlying fourth ventricle in normal fashion. Presenting thick wall of cyst removed. | Cerebellar tumor | Good recovery. Subsequent complete subsidence of symptoms. Perfect recovery to date (Aug 22 1936) | | |
| | | | | Headache and vomiting | III Jan 21 1936. Fiber Re-exploration (Horax). Re-exploration 90 c cm cyst overlying fourth ventricle in normal fashion. Presenting thick wall of cyst removed. | Cerebellar tumor | Good recovery. Subsequent complete subsidence of symptoms. Perfect recovery to date (Aug 22 1936) | | |
| | | | | Headache and vomiting | IV Feb 12 1936. Fiber Re-exploration (Horax). Re-exploration 90 c cm cyst overlying fourth ventricle in normal fashion. Presenting thick wall of cyst removed. | Cerebellar tumor | Good recovery. Subsequent complete subsidence of symptoms. Perfect recovery to date (Aug 22 1936) | | |
| 29 | 15 yrs | F | 1935 | Headache and vomiting | I Jan 21 1936. Exploratory. Evacuation marked foramen herniation. Partial removal. Zeller's operation. | Cerebellar tumor | Complete subsidence of symptoms. Perfect recovery to date (Aug 22 1936) | | Roentgen therapy V/D (x 19 8 Case 48) |
| | | | | Well developed syndrome | II Jan 21 1936. Re-exploration (Dr Ernest Sachs St. Louis). Evacuation 60 c cm cyst with partial removal. | Cerebellar tumor | Complete subsidence of symptoms. Perfect recovery to date (Aug 22 1936) | | |
| | | | | Recurrence | III Jan 21 1936. Re-exploration (Dr Ernest Sachs St. Louis). Evacuation 60 c cm cyst with partial removal. | Cerebellar tumor | Complete subsidence of symptoms. Perfect recovery to date (Aug 22 1936) | | |
| | | | | Recurrence | IV Jan 21 1936. Re-exploration (Dr Ernest Sachs St. Louis). Evacuation 60 c cm cyst with partial removal. | Cerebellar tumor | Complete subsidence of symptoms. Perfect recovery to date (Aug 22 1936) | | |

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DETER BENT BRIGHAM HOSPITAL SERIES—Cont ended

[illegible]

TABLE OF CASES

PETER BENT BACCHAM HOSPITAL SERIES—Continued

| Serial No. | Hospital No. name and date | Sex | Age | Duration (months) | Inaugural symptoms stage | Operative procedures | Contemporary pathological diagnoses | | | Convalescent results to date | Survival period from first operation | Previous references and comments |
|------------|------------------------------------|-----|--------|-------------------|------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------|-------------------------------|-------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------|-------------------------------------------------|
| | | | | | | | Pre-operative | Operative | Histological | | | |
| 41 | 22975 Doris Jan 6 1923 | M | 20 yrs | 7 | Headache and vomiting Early 3rd mo | 1 Jan 22, 1915. Usual lateral rhinotomy. Tumor resected. Intraoperative use of tumor retractor over fourth ventricle. Interior part of ventricle opened. 11 Mar 1926. Novocain-ether. Re-entrance of tumor by removal of portion of tumor with unhooking of feet. | Recurrent cerebellar astrocytoma O tumor fourth ventricle | Epiphyseal tumor | Astrocytoma fibrillare (1915) | Excellent recovery. Returned to work. Gained 50 lb. | Living 3 1/2 years | Roentgen therapy (6 hr) |
| 42 | Readmission Feb 5 1926 | | | 6 | Recurrent headache | 11 Mar 1926. Novocain-ether. Re-entrance of tumor by removal of portion of tumor with unhooking of feet. | Recurrent cerebellar astrocytoma O tumor fourth ventricle | | Astrocytoma fibrillare (1926) | Stomach convalescence. 11 Mar 1926. Novocain-ether. Re-entrance of tumor by removal of portion of tumor with unhooking of feet. 9 1926. | Living 3 1/2 years | Roentgen therapy (6 hr) |
| 43 | 34570 Johnston Aug 7 1915 | F | 21 yrs | 7 | Intermittent low back and leg pain. Not advanced | 1 Aug 11, 1915. Ether. Lumbar exploration. Tumor resected. Interior part of ventricle opened. 11 June 13, 1916. Novocain-ether. Radical electric surgical irrigation. Tumor resected. 11 June 27, 1916. Shaped tumor (11 June 27, 1916). | Cerebellar astrocytoma O tumor | Middle cerebellar astrocytoma | Glioma? | Excellent recovery. With 30 mg. of morphine (3 years 9 months). | Living 3 years | No roentgen therapy |
| 44 | 25318 Brow Dec 4 1915 | M | 23 yrs | 6 | Suboccipital headache. Dizziness. Advanced | Dec 12, 1915. Ether. White sulcus. Radical electric surgical irrigation. Tumor resected. 11 June 27, 1916. Shaped tumor (11 June 27, 1916). | Cerebellar astrocytoma O tumor | Cerebellar astrocytoma | Astrocytoma fibrillare (1915) | Postoperative hyperthermia. 11 June 27, 1916. Shaped tumor (11 June 27, 1916). | Living 3 years | |
| 45 | 26010 Aval Mar 27 1916 | M | 20 yrs | 7 | Frontal headache and vomiting. Advanced. Poor vision | Mar 27, 1916. Ether. Lumbar exploration. Tumor resected. 11 June 27, 1916. Shaped tumor (11 June 27, 1916). | Cerebellar astrocytoma O tumor | Cerebellar astrocytoma | Astrocytoma fibrillare (1916) | Discharged in excellent condition. 11 June 27, 1916. Shaped tumor (11 June 27, 1916). | Living 4 1/2 years | Roentgen therapy (400) supervised by beneficial |
| 46 | 26728 Fitzgerald Apr 17 1916 | M | 24 yrs | 12 | Headache and vomiting | Apr 17, 1916. Ether. Lumbar exploration. Tumor resected. 11 June 27, 1916. Shaped tumor (11 June 27, 1916). | Cerebellar astrocytoma O tumor | Cerebellar astrocytoma | Astrocytoma fibrillare (1916) | Discharged in excellent condition. 11 June 27, 1916. Shaped tumor (11 June 27, 1916). | Living 4 1/2 years | Roentgen therapy (400) supervised by beneficial |
| 47 | 16600 Goldstein June 21 1916 | F | 27 yrs | 3 | Intermittent vomiting. Advanced. Otic | June 21, 1916. Ether. Lumbar exploration. Tumor resected. 11 June 27, 1916. Shaped tumor (11 June 27, 1916). | Cerebellar astrocytoma O tumor | Cerebellar astrocytoma | Astrocytoma fibrillare (1916) | Discharged in excellent condition. 11 June 27, 1916. Shaped tumor (11 June 27, 1916). | Postoperative fatality | Roentgen therapy (400) supervised by beneficial |
| 48 | 27124 Stefan Sep 1 1916 | F | 24 yrs | 10 | Headache and vomiting. Advanced. Otic | Sept 1, 1916. Ether. Lumbar exploration. Tumor resected. 11 June 27, 1916. Shaped tumor (11 June 27, 1916). | Cerebellar astrocytoma O tumor | Cerebellar astrocytoma | Astrocytoma fibrillare (1916) | Discharged in excellent condition. 11 June 27, 1916. Shaped tumor (11 June 27, 1916). | Living 4 years | Roentgen therapy (400) supervised by beneficial |

| | | | | | | | | | | |
|------------------------------------|----|----------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------|---------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 37195 Lund Sept 27 1906 | 34 | Headache and vomiting 14th yr. frome | I Sept 19 1906 Novocain-ether Un- al 100 cc. + laminectomy atlas Marked pressure cone. Preliminary removal for diagnosis of large central vascular growth (fig 41A) | No large medullo- blastoma? | Astro- cytoma fourth ventricle (fig 41) | Insufficient tissue for diagnosis | Astrocytoma, proli- ferative (1927) al- most wholly fibrous (1909) (cf fig 44) | Prompt recovery, great improvement | Living 4 years | Roentgen then any reported C (6-1921) Case 7 1910 C (18 19) C (18 19) Case 18 First operation on brain, after which electro- surgical means were employed |
| Retinoma Apr 24 1927 | 35 | Visual return instability | II April 1 1927 1 liter Re-explora- tion. Total electro-surgical removal growth widely exposing fourth ven- tricle (fig 41B) | Mildere astro- cytoma fourth ventricle (fig 41) | Critical convalescence Postoperative hyper- thermia, hyperthermia normal brain to date first recovery to date (Sept 19 1920) | Excellent recovery though slight postop- erative hyperthermia Normal brain to date (Aug 15 1920) | Living 3 1/2 years | Single X-ray treatment Reported C (18-1919, Case 21) | | |
| 38136 Auerbach Feb 2 1927 | 36 | Headache and vomiting 14th yr. frome | Feb 10 1927 Other Usual approach Controlled tumor. Incision of vermis removal by suction widely opening fourth ventricle | Cerebellar tumor on ver- mis nodules? | Medullo- blastoma | Astrocytoma, fibrillar (1927) finely fibril- lary (throughout (1929) | Excellent recovery though slight postop- erative hyperthermia Normal brain to date (Aug 15 1920) | Living 3 1/2 years | | |
| 38224 MacMillan June 10 1927 | 37 | Tingling of head Advanced cere- bellar tumor | I June 21 1927 Filter Usual pro- cedure (Moray) Discs were large median fourth ventricle tumor in cistern left hemisphere. 1 segmentary removal by suction | Mildere astro- cytoma fourth ventricle | Cystic astro- cytoma | Astrocytoma, fibrillar (1927) densely fibrillar with calcification (1929) | Uncomplicated convales- cence persistent tilt- ing of head. Marked improvement to mor- row | Flourish 14 months to 1 year in fatality | | |
| Reidman July 17 1928 | 38 | Recurrent Cystic tumor | II Aug 19 1928 Novocain Re-explora- tion. Controlled tumor. Incision of vermis removal by suction widely opening fourth ventricle and tentorium | Recurrent astro- cytoma fourth ventricle | Recurrent astro- cytoma fourth ventricle | Astrocytoma, fibrillar (1927) densely fibrillar with calcification (1929) | Stormy postoperative course. Fatality with hyperthermia. Post- operative clot occlud- ing fistula | Living 1 year | Supravital meth- od if diagnosis introduced | |
| 20741 Ray Oct 27 1927 | 39 | Following trauma Head ache from early life bilateral cere- bellar convul- sions impaired vision | Oct 1 1927 Other Usual bilateraler puncture + laminectomy atlas. Whole ly controlled tumor. Incision vermis in closing deep cyst (100 cc.) 1 ver- mis removal by suction. Wide removal by electro-surgery Wide opening fourth ventricle | Right cerebellar astro- cytoma | Astrocytoma, fibrillar (1927) densely fibrillar with calcification (1929) | Postoperative all normal Symptoms Death days after 3 acute bilateral perforations with general peritonitis | Perfect recovery. Al- though 1 Normal health and activity to last re- port (Oct 4 1929) | Living 1 year | Supravital meth- od if diagnosis introduced | |
| 10115 Hays Nov 10 1927 | 40 | Dizziness Pain in back of neck Advanced cere- bellar tumor | Nov 20 1927 Novocain-ether Un- al suboccipital exploration + lami- nectomy atlas and 1 liter Huge mal- ignant growth from floor fourth ventricle incision from floor fourth ventricle removal by electro-surgery. Wide exposure ventricle and floor (fig 41) | Cerebellar tumor on ver- mis | Pendy monoma with final extension | Astrocytoma, fibrillar (1927) densely fibrillar with calcification (1929) | Postoperative all normal Symptoms Death days after 3 acute bilateral perforations with general peritonitis | Postoperative fatality | | |
| 10141 Hays Jan 11 1928 | 41 | Vomiting Advanced to vision atrophy | I Jan 15 1928 Novocain-ether Un- al bilateral exploration Median in- cision vermis exposing deep cystic tumor (100 cc.) with large mural nodule. Wide removal by electro- surgery on 1 section (fig 40) | Cystic astro- cytoma | Cystic astro- cytoma with high mural nodule | Astrocytoma, fibrillar (1927) densely fibrillar with calcification (1929) | Smooth convalescence with excellent recov- ery walking | Postoperative fatality | | |
| 10190 Hays Jan 19 1928 | 42 | Vomiting Recurrent attacks Advanced bilateral head choked disc | Jan 19 1928 Novocain Bilateral sub- occipital exploration Median in- cision vermis exposing huge cyst (25 cc.) with deep mural nodule. Total elec- tro-surgical removal of wall and open- ing of fourth ventricle (fig 40) | Fourth ventricle tumor | Cystic astro- cytoma with mural nodule | Astrocytoma, fibrillar (1927) densely fibrillar with calcification (1929) | Perfect recovery. Al- though 1 Normal health and activity to last re- port (Oct 4 1929) | Living 3 1/2 years | Cl Litch C (1928) Case 8 | |

PETER BRYN BRIGHAM HOSPITAL STAFF — Continued

| Ser. | No | Name and date | Sex | Age | Duration (months) | Inaugural symptoms stage | Operative procedures | Pre operative | Operative | Histological | Consilient notes Result to last report | Survival period from first operation | Previous references and comments |
|------|------|-----------------------|-----|---------|-------------------|---------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------|-------------------------------------|-------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------|----------------------------------|
| 68 | 3706 | Coffy Apr 5 1928 | F | 4 yrs. | 7+ | Subcapital hemiparesis after whooping cough Syndrome fully developed | Apr 27 1928 Novocain U shaped capital extirpation with evacuation c cm cyst right hemisphere large electrocortical extirpation base mural modile | Middle cerebral tumor multilocular fibrous glioma | Cystic fibrillar astrocytoma | Astrocytoma fibrillare (1928) Half postoperative fibrillary half moderately fibrillary (1930) | Symptom free to date (June 24 1930) 1st result | Living 2 1/2 years. | |
| 69 | 3735 | Owlin May 11 1928 | M | 27 yrs. | 24+ | Intermittent headache and vomiting Advanced to blindness Dementia Ab cure | May 19 1928 Perforated ventricles trisection May 18 emergency operation Non excised basal ganglia Vermian lobectomy Large vermian cyst (40 x 6 cm) Small lateral ventricle removed by electrocauterization Jaws intact little intact | Posterior fossa glioma | Melanotic glioma | Astrocytoma fibrillare (1928) densely fibrillary (1930) | Perfect recovery Symptom free except for loss of vision to last report (July 7 1930) | Living 25 1/2 years | |
| 70 | 3708 | Thompson July 12 1928 | M | 17 yrs. | (11 yrs.) | Vomiting attacks Age 4 to 6 Recurrence with advanced symptomatology | July 16 1928 Novocain U shaped extirpation Tumor exposed Ventricle incision Verminx Extensive removal huge tough medullary tumor complete surgery over fourth ventricle Residual shell of tumor over fourth ventricle | Cerebellar tumor | Melanotic astrocytoma | Astrocytoma fibrillare (1928) largely fibrillary with sheets of areas fibrilla (1930) | Perfect result Symptom free to date (Aug 31 1930) | Living 8 years | |
| 71 | 3774 | Golder Nov 23 1928 | F | 6 yrs. | 28 | Weakened at side | I Children's Hospital Boston April 13 1928 Confirmed cerebellar enlargement Discharge of suppuratively unacceptable tumor of pons (?) If free 1928 Novocain-ether Lissal lateral procedure + laminectomy atlas Incision of vermina Patenomy through incision Removal large nodular tumor from floor of cranial opening fourth ventricle (4 1/2 x 1 1/2) | Tumor of pons | Inoperable tumor | -- | Postoperative No further improvement temporary improvement for 3 months Complete freedom from symptoms Well active to date (Aug 23 1930) | Living 1 1/2 years | Report on later age |
| 72 | 3755 | Lideman Dec. 3 1928 | M | 16 yrs. | 7 yrs? | Headache and diplopia Advanced to near blindness and cerebellar seizures | Dec 3 1928 Ether U shaped exploration + laminectomy atlas Medulla incision vermina discharging large solid tumor Radical removal by electro-surgery and resection with full exposure fourth ventricle and floor | Right cerebellar tumor | Median astrocytoma | Astrocytoma fibrillare (1928) most rarely fibrillary with protoplasmic areas and calcification (1930) | Excellent general condition to date (Aug 23 1930) Impaired vision only residual | Living 1 1/2 years. | |
| 73 | 3706 | Meekers Dec. 31 1928 | M | 21 mos. | 6 | Unsteadiness of gait only Early symtom with hydrocephalus | Jan 5 1929 Novocain-ether U shaped incision These central cysts (60 cc m) with fat material cover roof fourth ventricle 1 striping n of cyst wall with removal specimen (growth) | Middle cerebellar tumor (medial lobe-tubercle?) | Cystic astrocytoma | Astrocytoma fibrillare (1929) scarcely fibrillary (1930) | Perfect recovery to date (June 13 1930) Rosier and Elms normally | Living 1 1/2 years. | |
| 74 | 3709 | Elliott Jan 20 1929 | F | 16 yrs. | 4 yrs. | No features Fully devel red eyes home with convulsions | Jan 23 1929 Novocain Equal perforation incision of vermina Excavation of middle gyrus (55 cc m) sectioning large mural tumor of left hemisphere Complete removal by electro-surgery (cf fig 34) | Middle cerebellar tumor | Cystic astrocytoma with mural tumor | Astrocytoma fibrillare (1929) chiefly protoplasmic fibrillary (1930) | Perfect recovery to date at college (Oct 6 1930) | Living 1 1/2 years | |

| | | | | | | | | | | |
|----|----------------------------------|----------------|-----|------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------|-------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------|
| 63 | 3362 Smith Feb 11 1929 | M 24 yrs | 9 | Headache and diplopia Advanced syndrome | Feb 16 1929 Novocain procedure Incision of vermis exposing cyst with deep dissection Postoperative vomiting Fourth ventricle widely opened | Cerebellar tumor | Cystic astro cytoma with meningeal nodule | Astrocytoma fibrillare (1929) scanty fib- rillary areas (1930) | Perfect recovery to last report (Oct 27 1930) Free from symptoms working steadily | Living 13½ years+ |
| 64 | 3366 Cohen Apr 6 1929 | M 4 yrs | 4 | Headache and vomiting Moderate | April 18 1929 Eth- er laminectomy atlas incision + laminectomy atlas incision of the posterior fossa. Removal of large ventricle had bare (Cf Fig 12) | Fourth ventricle tumor with lobes (toma?) | Median cystic astro cytoma fourth ventricle | Astrocytoma fibrillare (1929) largely pro- fusely fibrillary with sparse fibrils throughout (1930) | Stormy convalescence with hyperthermia Un- conscious and weak Stomach inoperative Discharged June 8 1929 Present normal health and ac- tivity (Sept 6 1930) | Living 13½ years |
| 65 | 3368 Cohen Apr 18 1929 | F 24 yrs | 24 | Unsteady gait Unable to impaired vision | April 22 1929 Novocain Tumor exposed Median incision of vermis Radical extirpation by electrocautery and incision of solid median tumor Wide ex- posure fourth ventricle | Median fibrillar tumor with bruit (sango blastoma?) | Median fibrillar astro cytoma fourth ventricle | Astrocytoma fibrillare (1929) moderately fibrillary with moderately fibrillary areas (1930) | Perfect operative re- covery Free from symptoms to date (July 5 1930) At school | Living 13½ years |
| 66 | 3371 Johnson June 28 1929 | F 15 yrs | 13 | Headaches and vomiting Advanced to near blindness | July 8 1929 Novocain procedure Puncture 60 c cm cyst left hemisphere Disclosure and total elec- trocautery extirpation large mural nodule under tentorium Thin roof fourth ventricle intact (Cf Fig 22) | Left cerebellar tumor | Cystic astro cytoma chiefly left hemi- sphere | Astrocytoma fibrillare (1929) moderately fibrillary (1930) | Perfect operative result Complete freedom from symptoms to date (June 7 1930) apart from impaired vision 20/20 | Living 11½ years |
| 67 | 3395 Lipshitz July 12 1929 | M 41 yrs | 13 | Occipital head aches vomiting and dizziness Advanced to near blindness Deafness | July 16 1929 Novocain procedure Tumor presenting at calamus Incision vermis Radical but incom- plete electrocautery extirpation partly cystic tumor with wide exposure fourth ventricle | Median cerebellar tumor | Median cystic astro cytoma fourth ventricle | Astrocytoma fibrillare (1929) scanty and finely fibrillary with highly vascular areas (1930) (Cf Figs 34 and 37) | Perfect operative result Avert from impaired vision 20/60 free from symptoms to date (Sept 6 1930) | Living 2 year |
| 68 | 3405 Lipshitz Dec 7 1929 | F 8 yrs | 4 | Periods of head aches and vom- iting Epileptic syndrome hology | Dec 17 1929 Novocain-ether procedure + laminectomy atlas Ex- posure large median solid midline tu- mor incomplete electrocautery ex- tinction of tumor under tentorium At- tempted brain biopsy (Cf Figs 14 and 15) | Median cerebellar tumor Astro cytoma? | Median solid astro cytoma of large size | Astrocytoma fibrillare (1929) densely fib- rillary with extensive oedematous areas (1930) (Cf Figs 34 and 37) | To symptomatic respiratory failure (2 hours) Au- topsy (Cf Fig 15) | Postoperative fatality |
| 69 | 3406 Lipshitz Jan 2 1930 | F 12 yrs | 2 | Impairment of vision first symptom Moderately advanced | Jan 13 1930 Novocain Incision vermis dissection Tumor exposed widely concealed tumor of large size and extensive electrocautery ex- tinction after scalping (Cf Fig 11) | Right cerebellar pontile tumor | Median non cystic astro cytoma | Astrocytoma densely fibrillary throughout (1930) | Stormy convalescence Postoperative night la- cal paralysed 1 xcel lent ultimate recovery Healthy Re school palsy vision greatly improved to date (Aug 24 1930) | Living 7 months |
| 70 | 3581 Hartstone Feb 17 1930 | F 7 yrs | 12+ | Unsteadiness Advanced to near blindness | Mar 3 1930 Novocain ether procedure + laminectomy atlas Tu- mor subcallosal Vertical incision vermis Electrocautery excision of large solid growth left incomplete with tentorium still over fourth ventricle (Cf Fig 13) | Cerebellar tumor necrosis biopsy Astro cytoma? | Median subcal- losal solid astro cytoma large size | Astrocytoma densely fibrillary (1930) | Perfect operative re- sult Free from disease apart from low dated vision (Sept 6 1930) | Living 6 months |

THE ETIOLOGICAL RÔLE OF GAS-FORMING BACILLI IN EXPERIMENTAL BILE PERITONITIS¹

ALLAN G. REWBIDGE, M.D., CHICAGO

From the Department of Surgery of the University of Chicago

THERE is a difference of opinion about the action of sterile bile on the peritoneum. Many surgeons believe that its deleterious action depends on the presence of bacteria rather than on the bile itself. Investigators, however, have shown that when sufficient amounts of bile are placed in the peritoneal cavity a fatal peritonitis is produced. Our purpose has been to study the sequence of events which follows the placing of sterile bile in the peritoneal cavity.

Clinically, peritonitis resulting from extravasations of bile is not exceedingly rare. Erdmann in 1903, reported 34 instances of spontaneous rupture of the gall bladder during typhoid fever. Twenty-seven were not operated upon and all died. Seven were operated upon and 4 recovered. McWilliams, in 1912, reported 108 cases of spontaneous perforations of infected biliary systems. Even though these cases received surgical treatment the mortality rate was 48 per cent.

The significance of the escape of sterile bile into the peritoneal cavity is not generally agreed upon. Courvoisier, in 1890, collected 34 instances of rupture of the biliary passages following trauma, of which 22 died and 12 recovered. In no instance did a patient recover without operation or puncture. Only 5 of these patients died within 24 hours and the sixth died within 48 hours. Hemorrhage from the liver was observed at necropsy in 3.

In 1905 Ricketts combined in a report 273 instances of spontaneous perforations and traumatic ruptures of the gall bladder and noted a better prognosis in the latter group. Two hundred twenty-four cases of spontaneous rupture of the gall bladder were reported, 64 were operated upon, of which 43 recovered and 21 died, 160 were not operated upon, of which 6 recovered and 154 died. In this series of 224 cases 67.2 per cent recovered following surgical treatment, while only 3.7 per cent recovered without surgical treatment. A critical

review of the 6 cases which recovered without operation fails to find any evidence of an intraperitoneal drainage of bile. Ricketts reported 40 instances of traumatic rupture of the gall bladder, 29 were operated upon, of which 22 recovered and 7 died, 20 were not operated upon, of which 4 recovered and 16 died. The duration of symptoms of the 16 cases which died without operation varied from 15 hours to 178 days. The prevailing cause of death as demonstrated by necropsy was peritonitis. Of the 4 patients who recovered without operation, the establishment of a fistula prevented death in 2 cases, in the third no evidence of an intraperitoneal drainage of bile was presented, while the fourth case is difficult to believe. Sabatier reported this case, which lived for 7 years following injury. "At necropsy the gall bladder was empty and the peritoneal cavity was filled with pure bile." In this series of 49 cases of traumatic etiology 75.8 per cent recovered after operation, while only 20 per cent recovered without an operation. The period of operation varied from immediately after the injury to several weeks later. The amount of fluid removed varied from a few ounces to 3 gallons and has been described as pure bile, blood, or pus, one or all combined. Death has been due to shock, infection, and hemorrhage, and has taken place from 1 hour to several weeks after the injury.

Amante collected 101 instances of rupture of the biliary passages and states that without intervention such an injury is usually fatal, due to the toxæmia from the absorbed bile.

In 1918 Buchanan collected 17 cases of rupture of the gall bladder with a mortality of 9 out of 17 cases. Twelve of the 14 cases which were complicated by infection were treated surgically with a mortality rate of 50 per cent. Both of the patients not operated upon died. The 3 patients with a traumatic history were treated surgically with a mortality rate of 33

¹This work has been done under a grant from the Douglas Smith Foundation of Medical Research of the University of Chicago. This paper was read before the Chicago Surgical Society, November 7, 1930.

TABLE I—THE EFFECT OF AN INTRAPERITONEAL INJECTION OF BILE UPON THE INTENSITY OF THE PITTENKOFER REACTION OF BLOOD

| Dog | Cm. of bile per kilogram | Before operation | Hours after the injection | | | | | | | Result |
|-----|--------------------------|------------------|---------------------------|-------|-------|------|------|------|------|-----------|
| | | | 0.5 | 1.5 | 2.5 | 3.5 | 4.5 | 5.5 | 24 | |
| 1 | 1 | 3.65 | 6.06 | 8.62 | 7.46 | 6.94 | 5.95 | 5.31 | 3.78 | Recovered |
| 2 | 1 | 5.86 | 6.42 | 7.35 | 5.91 | 4.84 | 5.32 | 5.15 | 5.40 | Recovered |
| 3 | 1 | 3.88 | 4.23 | 4.54 | 4.00 | 3.93 | 4.27 | 3.74 | 3.92 | Recovered |
| 4 | 1 | 3.57 | 4.56 | 4.84 | 3.78 | 3.51 | 3.26 | 3.40 | 3.32 | Recovered |
| 5 | 1 | 5.25 | 7.02 | 7.63 | 6.70 | 5.77 | 5.31 | 5.62 | 5.10 | Recovered |
| 6 | 2 | 5.34 | 7.02 | 10.41 | 7.63 | 7.46 | 5.71 | 4.70 | 5.43 | Recovered |
| 7 | 2 | 4.36 | 8.56 | 12.02 | 10.57 | 6.63 | 5.78 | 5.67 | 5.85 | Recovered |
| 8 | 2 | 5.5 | 5.39 | 7.14 | 4.63 | 4.98 | 4.34 | 5.23 | 5.46 | Recovered |
| 9 | 2 | 3.23 | 8.19 | 12.34 | 7.14 | 5.32 | 4.72 | 4.70 | 5.15 | Recovered |
| 10 | 3 | 4.41 | 5.67 | 7.03 | 5.81 | 5.63 | 5.45 | 5.20 | 4.63 | Recovered |
| 11 | 3 | 4.14 | 9.37 | 10.11 | 5.35 | 5.35 | 4.42 | 4.46 | 3.91 | Recovered |
| 12 | 1 | 1.79 | 6.11 | 9.26 | 8.20 | 5.11 | 5.21 | 4.41 | 4.14 | Recovered |

Pittenkofer values in terms of milligrams of glyeochole acid per 100 c. cm. of blood

per cent. In 8 cases the duration of symptoms varied from 1 to 6 days with a mortality rate of 50 per cent. In 5 cases the duration of symptoms varied from 7 to 27 days with a mortality rate of 80 per cent.

A number of investigators have studied this problem and have concluded that sterile bile may be present in the peritoneal cavity without harm. Frankel and Krause, in 1899, injected bile into the peritoneal cavity of guinea pigs and dogs without observing untoward effects. After cutting the dogs' gall bladders with scissors the result was the same. When necropsies were performed 2 to 5 weeks later the wounds in the gall bladder had either healed or had been closed by omentum or loops of intestine.

Ehrhardt, in 1901, ligated the supraduodenal portion of the common bile duct of 12 dogs and cats, cut the duct above the ligature, and slit the proximal end of the duct a little. His animals died within 2 to 6 days with a progressive icterus. At necropsy the peritoneum was normal. He attributed the cause of death to the cholæmia from the absorbed bile. In two cats he cut a hole in the gall bladder and placed a culture of dead bacillus coli in the peritoneal cavity. Both animals were well at the end of 2 weeks. Two experiments done subsequently with staphylococcus gave the same results. Ehrhardt con-

cluded then that bile depressed the virulence of bacteria and that injection protected against death from cholæmia.

Noetzel, in 1910, cut a hole in the gall bladder of each of 17 rabbits. Sixteen recovered and only 1 died. Noetzel concluded from that that the wounds of the gall bladder heal rapidly and that the escape of bile into the peritoneal cavity is innocuous.

Wagensteen, in 1926, showed that the establishment of a well functioning fistula is essential to determine the significance of the escape of sterile bile into the peritoneal cavity. After ligating the common bile duct in 6 dogs and cutting a hole in the gall bladder, these animals died within 24 hours. The procedure was repeated in rabbits with the same result. In 4 other dogs the common bile duct was divided and the distal end ligated. These dogs died within 48 hours. The experiment was repeated in rabbits with the same result. The bile in the peritoneal cavity at necropsy was sterile, consequently he attributed the cause of death to the toxicity of the bile.

Horrell, in 1929, confirmed the findings of Wagensteen by observing that in the dog the continuous drainage of bile into the peritoneal cavity is fatal within 24 hours. He attributed the deaths to the toxicity of the bile salts. As bile peritonitis is considered a toxæmia, experiments were made to test this hypothesis.

TABLE II--THE EFFECT OF AN INTRAPERITONEAL INJECTION OF BILE UPON THE LEVEL OF BILIRUBIN IN BLOOD

| Dog | C cm of bile per kilogram | Before operation | Hours after the injection | | | | | | |
|-----|---------------------------|------------------|---------------------------|-------|-------|-----|-----|-----|-----|
| | | | 0 5 | 1 5 | 2 5 | 3 5 | 4 5 | 5 5 | 24 |
| 1 | 1 | 0 0 | 0 0 | 0 0 | 0 0 | 0 0 | 0 0 | 0 0 | 0 0 |
| 2 | 1 | 0 0 | 0 0 | 0 0 | 0 0 | 0 0 | 0 0 | 0 0 | 0 0 |
| 3 | 1 | 0 0 | 0 0 | 0 0 | 0 0 | 0 0 | 0 0 | 0 0 | 0 0 |
| 4 | 1 | 0 0 | 0 0 | 0 0 | 0 0 | 0 0 | 0 0 | 0 0 | 0 0 |
| 5 | 1 | 0 0 | Trace | Trace | Trace | 0 0 | 0 0 | 0 0 | 0 0 |
| 6 | 2 | 0 0 | 0 0 | Trace | Trace | 0 0 | 0 0 | 0 0 | 0 0 |
| 7 | 2 | 0 0 | 0 0 | Trace | 0 0 | 0 0 | 0 0 | 0 0 | 0 0 |
| 8 | 2 | 0 0 | 0 0 | 0 0 | 0 0 | 0 0 | 0 0 | 0 0 | 0 0 |
| 9 | 2 | 0 0 | 0 0 | 0 0 | 0 0 | 0 0 | 0 0 | 0 0 | 0 0 |
| 10 | 3 | 0 0 | Trace | Trace | Trace | 0 0 | 0 0 | 0 0 | 0 0 |
| 11 | 3 | 0 0 | Trace | Trace | Trace | 0 0 | 0 0 | 0 0 | 0 0 |
| 12 | 3 | 0 0 | 0 0 | 0 0 | 0 0 | 0 0 | 0 0 | 0 0 | 0 0 |

METHODS

Bilirubin was determined quantitatively by the Van den Bergh method and the bile salts by the quantitative Pettenkofer reaction devised by Aldrich.

Experiments. In this experiment the effect of an intraperitoneal injection of bile was measured by determining the amount of bilirubin and bile salts which were entering the blood. These determinations are charted on Tables I and II and show that only minor and transient changes in the blood occur when bile is administered intraperitoneally.

Bile peritonitis was then produced by allowing bile to drain continuously into the peritoneal cavity. This was done by making a stoma in the gall bladder after the ductus choledochus was ligated and divided. The effect of this procedure was then studied by determining the amounts of bilirubin and bile salts entering the blood. No increase in bilirubin and bile salts could be detected in blood drawn 18 hours after the bile was allowed to drain into the peritoneal cavity, even though these animals were moribund as to the result of this procedure. These observations show that the cause of death is obviously not the circulation of the bile salts in the blood at toxic levels.

Of the 20 dogs in this experiment, 6 were dead and 14 were moribund 18 hours after their operations. Necropsies were performed

(immediately after the electrocution of the living animals, and on the ones found dead) and may be summarized as follows.

The peritoneal cavity presented the picture of an acute severe general peritonitis and contained several hundred cubic centimeters of a bile stained serosanguineous exudate. The peritoneum was fiery red, numerous petechiae and small subperitoneal hemorrhages were present and the peritoneal surfaces were covered with a thin layer of fibrin. Around the pancreas were a few small areas of fat necrosis.

This peritoneal exudate contained polymorphonuclear leucocytes and large gram positive bacilli. The results of a bacteriological study of this exudate are recorded in Tables III and IV and show the presence of a gram positive bacillus which grew exceedingly well under anaerobic conditions, and which was present in the peritoneal exudates of all of the twenty dogs in this series. Aerobic cultures of this exudate contained organisms in two instances, in one *staphylococcus aureus* was present, in the other both *staphylococcus aureus* and *bacillus coli* were observed. The presence of these aerobic organisms may be accounted for on the basis of either contamination or postmortem invasion. Since the anaerobic gram positive bacillus was present in the exudates of all of the dogs, its presence must be significant if it is possible to exclude contamination and postmortem invasion. The

TABLE III—BACTERIOLOGICAL STUDIES OF BILE PERITONITIS

| Dog | Smear | Aerobic blood agar plate | Anaerobic meat | Anaerobic blood agar plate | Remarks |
|-----|---------------------------|--------------------------------------------|-----------------|-----------------------------------------------------------------------|---------------|
| 13 | Gram + bacillus | No growth | Gram + bacillus | 1 Gram + bacillus 2 Gram + coccus in clusters 3 Gram - bacillus | Killed |
| 14 | Gram + bacillus pus cells | No growth | Gram + bacillus | Gram + bacillus | Fresh autopsy |
| 15 | Gram + bacillus pus cell | No growth | Gram + bacillus | Gram + bacillus | Killed |
| 16 | Gram + bacillus pus cells | 1 Bacillus coli 2 Staphylococcus aureus | Gram + bacillus | Gram + bacillus | Found dead |
| 17 | Gram + bacillus pus cells | 1 Staphylococcus aureus | Gram + bacillus | Gram + bacillus | Killed |
| 18 | Gram + bacillus pus cells | No growth | Gram + bacillus | Gram + bacillus | Found dead |
| 19 | Gram + bacillus pus cells | No growth | Gram + bacillus | Gram + bacillus | Killed |
| 20 | Gram + bacillus | No growth | Gram + bacillus | Gram + bacillus | Killed |

media previous to use in this experiment was sterile after 24 hours of incubation. Inasmuch as this organism is not a common contaminant, it seems that it would be incredible to contaminate twenty consecutive cultures with it. As for the possibility that it might be a postmortem invader, the following data is of interest. In this series of 20 dogs, 14 had been killed immediately before the bacteriological study was made. Since this organism was present in both the smears and cultures of this exudate, it seems reasonable to assume that they were present during life if it can be shown that postmortem invasion does not occur within 2 minutes after electrocution. Five normal, healthy dogs were electrocuted, their abdomens immediately opened and a bacteriological study made of their peritoneal cavities. Milk media was used in this experiment and the results are recorded in Table V. These cultures were all sterile except one, in which grew staphylococcus aureus, a contaminant, and shows conclusively that postmortem invasion does not take place under the conditions of this experiment and that the cultures of the 14 dogs taken immediately after electrocution represent the condition which existed during life. The question then arose as to how soon following the operation did this large gram positive bacillus invade the peritoneal cavity. A bacteriological study of the peritoneal exudates of 24 dogs with bile draining into their peritoneal cavities was made at intervals of 2½, 5, and 10 hours after their operations. The results are recorded in Table VI and may be summarized as follows:

In the dogs of the 2½ hour class organisms were present in 5 of 8 dogs. In one animal large gram positive anaerobic bacilli and gram positive cocci in chains were observed. The streptococcus and bacillus coli were present in the exudates of the 4 other dogs. In the 5 hour class the anaerobic bacillus was present in 4 of the 8 dogs, and in the 10 hour class, in 7 of 8. In experiments of longer duration the streptococcus and bacillus coli were present in relatively fewer numbers. The fact that in the later hours of the experiment this gram positive bacillus was present in nearly pure culture may be explained on the basis of an overgrowth phenomenon. Although organisms other than this anaerobic bacillus have invaded the peritoneal cavity along with the anaerobic bacillus early in the experiment, the latter organism grew more rapidly so that when cultures were made 18 hours after the operation, only the anaerobic bacillus was to be found.

Since the gram positive bacillus was present in both the smears and cultures of the exudates of twenty dogs in all instances, and that contamination antemortem and postmortem invasion have been excluded, this anaerobic bacillus should be considered as a possible cause of the peritonitis.

A study of the peritoneal reaction to this organism was then made by introducing broth cultures of it intraperitoneally and a peritonitis identical with bile peritonitis was produced. Cultures of the resulting exudate contained anaerobic gram positive bacilli identical culturally with those isolated from dogs

TABLE IV—BACTERIOLOGICAL STUDY OF BILE PERITONITIS

| Dog | Exudate smear | Anaerobic meat media | Smear | Anaerobic milk media | Smear | Remarks |
|-----|---------------------------|----------------------|-----------------|----------------------|-----------------|--------------------|
| 21 | Gram + bacillus | Gas + turbidity | Gram + bacillus | Stormy fermentation | Gram + bacillus | Killed |
| 22 | Gram + bacillus | Gas + turbidity | Gram + bacillus | Stormy fermentation | Gram + bacillus | Killed |
| 23 | Gram + bacillus pus cells | Gas + turbidity | Gram + bacillus | Stormy fermentation | Gram + bacillus | Killed |
| 24 | Gram + bacillus pus cells | Gas + turbidity | Gram + bacillus | Stormy fermentation | Gram + bacillus | Killed |
| 25 | Gram + bacillus pus cells | Gas turbidity | Gram + bacillus | Stormy fermentation | Gram + bacillus | Killed |
| 26 | Gram + bacillus pus cells | Gas turbidity | Gram + bacillus | Stormy fermentation | Gram + bacillus | Found dead in cage |
| 27 | Gram + bacillus pus cells | Gas turbidity | Gram + bacillus | Stormy fermentation | Gram + bacillus | Found dead in cage |
| 28 | Gram + bacillus pus cells | Gas turbidity | Gram + bacillus | Stormy fermentation | Gram + bacillus | Killed |
| 29 | Gram + bacillus pus cells | Gas turbidity | Gram + bacillus | Stormy fermentation | Gram + bacillus | Killed |
| 30 | Gram + bacillus pus cells | Gas turbidity | Gram + bacillus | Stormy fermentation | Gram + bacillus | Found dead in cage |
| 31 | Gram + bacillus pus cells | Gas turbidity | Gram + bacillus | Stormy fermentation | Gram + bacillus | Killed |
| 32 | Gram + bacillus pus cells | Gas turbidity | Gram + bacillus | Stormy fermentation | Gram + bacillus | Killed |

dyng of bile peritonitis. The results of this experiment are recorded in Table VII. Inasmuch as it was necessary to introduce at least 20 cubic centimeters of a culture in order to produce a fatal peritonitis, and that necropsies of animals receiving less furnished no evidence of a previous inflammatory process, the question then arose as to whether the bile was lowering the peritoneal resistance to infection. When mixtures of bile and broth cultures in sublethal amounts were introduced into the peritoneal cavity, it was possible to lower the minimal lethal dose of a broth culture from 20 to 5 cubic centimeters, showing that the presence of bile facilitates the development of peritonitis. This experiment is described in Table VIII.

The source of this infection was the next problem to be solved. Were the organisms entering the peritoneal cavity with the bile, or was the bile altering the permeability of viscera containing bacteria to permit peritoneal invasion? Cultures of bile removed from the gall bladders of 20 dogs at the time of operation were all sterile except one, in which grew a short gram negative bacillus. This experiment shows that the bile of healthy dogs is sterile.

The effect of sterile bile salt solutions on the peritoneum was then studied. A 10 per cent solution of bile salts, filtered through a Berk-

field filter and shown to be sterile when introduced into the peritoneal cavity, was administered in amounts varying from 2.5 to 4 cubic centimeters per kilogram of body weight. The appearance of the peritoneal cavity was essentially the same as was observed in bile peritonitis, except that fat necrosis was more extensive. The serosanguineous exudate contained polymorphonuclear leucocytes and large gram positive bacilli which had the same morphologic and cultural characteristics as those organisms observed in bile peritonitis. Of this series of 20 dogs, 11 had died and 9 were moribund 18 hours after the bile salts solution had been introduced through a laparotomy incision. Since it was possible to find this organism in the exudates of 19 dogs and that 8 of these had been killed immediately before the cultures were taken, it seems reasonable to assume that these organisms had invaded the peritoneal cavity during life and that they were not postmortem invaders. The results of this experiment are recorded on Table IX and show that a septic peritonitis may be produced by sterile bile salt solutions and suggest a new mechanism for infection.

This bacillus, an anaerobic organism, grows readily in broth, and in milk produces a stormy fermentation within 18 hours. On an anaerobic blood agar plate the colony is large, is gray in color, and is surrounded by a zone

TABLE V.—CULTURES OF THE NORMAL PERITONEUM OF DOGS TAKEN WITHIN TWO MINUTES AFTER ELECTROCUTION

| | | Duration of incubation | | |
|-------|---|------------------------|--------------|--------------|
| | | 24 hrs | 48 hrs | 72 hrs |
| Dog A | a | No growth | No growth | No growth |
| | b | No growth | No growth | No growth |
| Dog B | a | No growth | No growth | No growth |
| | b | No growth | Staph aureus | Staph aureus |
| Dog C | a | No growth | No growth | No growth |
| | b | No growth | No growth | No growth |
| Dog D | a | No growth | No growth | No growth |
| | b | No growth | No growth | No growth |
| Dog E | a | No growth | No growth | No growth |
| | b | No growth | No growth | No growth |

TABLE VI.—THE PRESENCE OF ANAEROBIC BACILLI IN THE PERITONEAL EXUDATES OF LIVING DOGS WITH BILE PERITONITIS

| Number of dogs | Bile draining into the peritoneal cavity for a period of | Anaerobic bacilli present in the exudate of | Percentage of positive cultures |
|----------------|----------------------------------------------------------|---------------------------------------------|---------------------------------|
| 8 | 15 hrs | 1 dog | 12.5 per cent |
| 8 | 50 hrs | 4 dogs | 50.0 per cent |
| 8 | 100 hrs | 7 dogs | 87.5 per cent |

of beta hæmolytic. It stains well with methylene blue and positively by Gram's method. It varies considerably in length, has flat ends and produces spores. In smears it appears singly, in pairs, or in short chains. This organism has the same morphology and cultural characteristics as *Bacillus welchii* and in the remainder of the paper it will be referred to as *Bacillus welchii*.

Wagensteen and Horrall in recent investigations showed that the continuous drainage of bile into the peritoneal cavity produced a fatal peritonitis in dogs and attributed the cause of death to the toxicity of the bile. Experimental data, however, shows that the cause of death in bile peritonitis is not due to the circulation of the bile salts in the blood at toxic levels because no increase of bilirubin or bile salts was found even though the dogs were moribund as the result of peritonitis. The cause of death must be due to the local action of the bile in the peritoneal cavity and the secondary changes produced by it.

The finding of *Bacillus welchii* in the peritoneal exudates of 20 dogs dying from bile

TABLE VII.—PERITONITIS PRODUCED BY EIGHT-HOUR BROTH CULTURES OF THE ANAEROBIC BACILLUS

| No. of dogs | Amount of culture in c cm | Results |
|-------------|---------------------------|---------------------|
| 1 | 50 | Death within 18 hrs |
| 1 | 40 | Death within 18 hrs |
| 1 | 30 | Death within 18 hrs |
| 3 | 20 | Death within 18 hrs |
| 3 | 15 | Recovery |
| 1 | 10 | Recovery |
| 1 | 5 | Recovery |

TABLE VIII.—THE EFFECT OF THE INTRAPERITONEAL ADMINISTRATION OF MIXTURES OF BILE AND BROTH CULTURES

| No. of dogs | Ccm of bile per kilogram | Ccm. of culture introduced | Results |
|-------------|--------------------------|----------------------------|---------------------|
| 2 | 1 | 15 | Death within 18 hrs |
| 2 | 1 | 10 | Death within 18 hrs |
| 2 | 1 | 5 | Death within 18 hrs |

peritonitis suggested the septic nature of the process. The production of an inflammation identical with bile peritonitis by cultures of this organism supports this concept. Observations are presented which show that *Bacillus welchii* is not a normal inhabitant of the bile but invades the peritoneal cavity as the result of the local action of the bile salts on the viscera containing bacteria. The most probable explanation of this phenomenon is on the basis of permeability changes which are produced by the bile salts.

CONCLUSIONS

1. Bile peritonitis in dogs is an infection.
2. *Bacillus welchii* invades the peritoneal cavity, presumably as the result of permeability changes produced by the local action of the bile salts in the peritoneal cavity.
3. A peritonitis identical with bile peritonitis was produced by *Bacillus welchii*.
4. Examination of the blood for bilirubin and bile salts is of no value in determining the amount of drainage of bile into the peritoneal cavity.
5. These conclusions are confined to the action of bile on the dog's peritoneum.

TABLE IX.—A BACTERIOLOGICAL STUDY OF EXPERIMENTAL BILE SALTS PERITONITIS

| Dog | Cultures of normal peritoneum in milk | Cultures of bile salt filtrate in milk | Peritoneal exudate cultured in | | | | | |
|-----|---------------------------------------|----------------------------------------|--------------------------------|-------------------|-----------------|---------------------|---------------------|---------------|
| | | | Exudate smear | Meat (anserine) | Smear | Milk | Smear | Remarks |
| 33 | No growth | No growth | Gram + rod pus cells | Gas—turbidity | Gram + bacillus | Stormy fermentation | Gram + bacillus | Killed |
| 34 | No growth | No growth | Gram + rod pus cells | Gas—turbidity | Gram + bacillus | Stormy fermentation | Gram + bacillus | Killed |
| 35 | No growth | No growth | Gram + rod pus cells | Gas and turbidity | Gram + bacillus | Stormy fermentation | Gram + bacillus | Found dead |
| 36 | No growth | No growth | Gram + rod pus cells | Gas and turbidity | Gram + bacillus | Stormy fermentation | Gram + fermentation | Found dead |
| 37 | No growth | No growth | Gram + rod pus cells | Gas and turbidity | Gram + bacillus | Stormy fermentation | Gram + bacillus | Fresh autopsy |
| 38 | No growth | No growth | Gram + rod pus cells | Gas and turbidity | Gram + bacillus | Stormy fermentation | Gram + bacillus | Found dead |
| 39 | No growth | No growth | Gram + rod pus cells | Gas and turbidity | Gram + bacillus | Stormy fermentation | Gram + bacillus | Found dead |
| 40 | No growth | No growth | Gram + rod pus cells | Gas and turbidity | Gram + bacillus | Stormy fermentation | Gram + bacillus | Found dead |
| 41 | No growth | No growth | Gram + rod pus cells | Gas and turbidity | Gram + bacillus | Stormy fermentation | Gram + bacillus | Fresh autopsy |
| 42 | No growth | No growth | Pus cells | No growth | Negative | No growth | Negative | Killed |
| 43 | No growth | No growth | Gram + rod pus cells | Gas and turbidity | Gram + bacillus | Stormy fermentation | Gram + bacillus | Found dead |
| 44 | No growth | No growth | Gram + rod pus cells | Gas and turbidity | Gram + bacillus | Stormy fermentation | Gram + bacillus | Fresh autopsy |
| 45 | No growth | No growth | Gram + rod pus cells | Gas and turbidity | Gram + bacillus | Stormy fermentation | Gram + bacillus | Fresh autopsy |
| 46 | No growth | No growth | Gram + rod pus cells | Gas and turbidity | Gram + bacillus | Stormy fermentation | Gram + bacillus | Fresh autopsy |
| 47 | No growth | No growth | Gram + rod pus cells | Gas and turbidity | Gram + bacillus | Stormy fermentation | Gram + bacillus | Killed |
| 48 | No growth | No growth | Gram + rod pus cells | Gas and turbidity | Gram + bacillus | Stormy fermentation | Gram + bacillus | Killed |
| 49 | No growth | No growth | Gram + rod pus cells | Gas and turbidity | Gram + bacillus | Stormy fermentation | Gram + bacillus | Killed |
| 50 | No growth | No growth | Gram + rod pus cells | Gas and turbidity | Gram + bacillus | Stormy fermentation | Gram + bacillus | Killed |
| 51 | No growth | No growth | Gram + rod pus cells | Gas and turbidity | Gram + bacillus | Stormy fermentation | Gram + bacillus | Killed |
| 52 | No growth | No growth | Gram + rod pus cells | Gas and turbidity | Gram + bacillus | Stormy fermentation | Gram + bacillus | Killed |

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TRANSPLANTATION OF THE URETERS TO THE SIGMOID

AN EXPERIMENTAL STUDY IN DOGS

IRA K. SISK, M.D., F.A.C.S., JOHN B. WEAKE, M.D., and HAROLD A. ORKIN, M.D., MADISON, WISCONSIN
 Department of Urology, University of Wisconsin School of Medicine

BELIEVING that the development and execution of a surgical procedure must have a clear and well understood physiological and pathological background, we have undertaken this animal experimentation. The surgical technique of ureteral transplantation has made rapid progress since 1909, but for obvious reasons there has not been a corresponding progress in the end results of such cases. Overenthusiasm can do irreparable damage to any new surgical procedure unless the limitations and possible remote changes in the organism are well understood. A study of the current literature suggests that we are approaching such a state in transplantation of the ureters into the large bowel. We believe that the techniques variously advocated are not sufficiently stabilized for the operation to be regarded lightly.

The battlefield of investigation has been far flung, but the privilege of employing this operation in a number of human patients has fallen to only a few men. For that reason reported efforts of isolated investigators on a small scale will aid in completing the picture.

An extensive review of the literature would be futile at this time. Only those articles which are pertinent to the purpose of this paper are included for discussion. The development of Coffey's technique is the most significant factor on this subject in the American literature. His three major contributions were (1) the mucous membrane valve which adequately prevents regurgitation of fecal material up the ureter, (2) the use of tubes to prevent postoperative occlusion of the ureters, (3) the extensive cleansing of the lower bowel to insure a relatively sterile operative field.

In 1929 he reported 20 cases on whom this technique had been used. Autopsies were done on 3 of the 5 patients who died. Two of the three, Cases 7 and 8, had extensive carcinomata of the bladder and died 75 and 290

days after operation. Microscopic examination of the kidneys showed a mild leucocytic infiltration and parenchymatous degeneration. One, Case 20, died 6 days after operation and the pathologist found normal kidneys. From his own personal experience he believes that both the problem and the technique have been solved and that the operation may be safely recommended to skilled surgeons.

To C. H. Mayo belongs the credit for the widest clinical experience with ureteral transplantation. In 1924, he reported a series of 33 cases. Both ureters were transplanted in 28 patients, 1 died of peritonitis and 23 patients have been followed. Five complain of lumbar pain at times, otherwise there are no complaints. Mayo's technique differs from the completed Coffey technique in that (1) he does the operation in two stages, (2) he does not use tubes, and (3) he does not clean the lower bowel so extensively. The one step common to both is the mucous membrane valve, yet their results are quite parallel.

After noting these two procedures and results, a study of Turner's review of 17 personal cases is interesting if not confusing. He used neither the Coffey nor Mayo techniques but that of Stiles, which does not form a mucous membrane valve. There were 4 deaths, 3 from peritonitis and 1 due to septic dermatitis. There are 10 patients living and well from 7 months to 15 years after operation. The report is particularly valuable because it contains full follow-up notes on the living and the autopsy records of the dead. One patient died 3 years after operation from intestinal obstruction and 1 died 2 years after operation from a plastic operation on the bladder. The progress in these cases up to the time of death did not indicate renal infection, but autopsy revealed a pyonephrosis in 1 case and a hydropneumonephrosis with dilated ureter in the other case.

Turner urges particularly that as much of the blood supply to the ureters as possible be saved and in his operation he stresses (1) the two-stage operation, (2) the Mayo catgut urine guide, and (3) a drain tube from the area of anastomosis. He has also observed the frequency of attacks of renal infection soon after the operation, from which the patient readily recovers, and he believes that moderate renal infection is not inconsistent with average good health. The more than casual relationship of an impeded opening into the bowel to infection has also been recognized by Turner. He could not force water up the ureters in his autopsy specimens.

The three foregoing clinical reports although the cream of the current literature, offer little aid in studying the pathology and physiology of transplanted ureters. To depend upon the human subject for this information means many years of waiting, and then the reported cases will be few and scattered. Obviously then, animals offer a solution, and to McKenna belongs the credit for studying end-results over a period of time. His was the first work in which dogs lived for more than a year with a transplanted ureter. The successful results which he published prompted us to apply this investigation with a broader purpose. He transplanted one ureter by the Coffey technique, and 3 dogs were allowed to live 14 months and 1 dog 24 months. He studied the function and bacteriology. In every case the function was normal in the transplanted kidney, and cultures from both sides were sterile. Our experience with the operation in dogs has not been as satisfactory as McKenna's, and we believe it will show that the last word has not been said concerning renal infection.

Female dogs were used in this work because the external male genitalia interfere both with the surgical exposure and the cleanliness of the operative field. On the whole, dogs are well adapted for this type of investigation. However, they do not withstand infection very well because of poor general resistance and the highly virulent bacteria present in the normal intestinal flora. The only technical difficulty arises from the thick and rigid muscular coat of the bowel wall, which makes

closure of the anastomosis more difficult and less secure than in the human. We believe that our results demonstrated that in these animals the operative technique may be executed with relative ease and that peritonitis arising from soiling by the opening of the bowel, even though no drainage is used, is not a serious factor. In only one animal did we feel that peritonitis was caused by soiling at the time of the operation. Two other animals developed peritonitis, in one it resulted from a severe wound infection and in the other from evisceration in a pregnant dog in which operation was attempted too near term.

This study is composed of 31 operations performed on 29 dogs. One of the purposes of the work was to compare the end-results of ureteral transplantation, when the techniques is described by Mayo and Coffey in the individual reports of their work were used. The operative techniques have been so fully described elsewhere that no details need be given here. In every case we used the submucous implantation as originally developed by Coffey. In one group of cases we followed the operative technique as described by Mayo, allowing for single transplantation, and in the second major group we followed the recent technique of Coffey, permitting bilateral transplantation by using ureteral catheters as well as the cleansing of the lower bowel.

Hence, we shall hereafter refer to the one as the Mayo technique, in which no ureteral catheters were used, and designate as the Coffey operation that which followed the operative technique described in Coffey's later publication.

MAYO TECHNIQUE, ONE URETER TRANSPLANTED

In 7 animals, 1, 4, 5, 6, 7, 8, and 11, a single ureter was transplanted by the Mayo technique. Dog 1 was killed on the seventh day because of complete evisceration of the abdominal contents. Two died on the fifty-sixth and ninety-fourth days, and for various reasons the others were killed on the thirty-second, fifty-sixth, sixty-eighth, and one hundred nineteenth days. The complete records of these dogs follows.

Dog 1 The right ureter was transplanted into the sigmoid June 6 1929. The dog was killed 7 days later because of complete evisceration. The autopsy showed a small amount of pus in the right perineal area. Neither the ureter nor the pelvis of the right kidney were dilated. The area of the anastomosis was well healed and showed no evidence of leakage. The right kidney, ureter, and the sigmoid were removed intact. When the sigmoid was opened no ureteral opening could be demonstrated and a fine probe passed down the ureter presented beneath the mucosa which was smooth in this area. No microscopic sections were obtained.

Dog 4 The right ureter was transplanted into the sigmoid July 7 1929. The dog recovered without incident but contracted mange so badly that it was necessary to kill her November 25, 119 days after operation. The peritoneum was smooth and glistening throughout. There were a few adhesions in the region of the anastomosis. The right kidney, ureter, and the sigmoid were removed intact. The pelvis and ureter were not dilated but the kidney was one third as large as the left. The area of the anastomosis was perfectly healed. On gross section there was much fibrosis in the cortical area of the right kidney. A No. 4 pointed ureteral catheter passed down the ureter entered the sigmoid without obstruction. The left kidney appeared entirely normal. No gross evidence of pus was found in urinary tract. The non-protein nitrogen content before death was 35 milligrams.

Microscopic sections of the right kidney showed a diffuse cellular infiltration, with marked fibrosis throughout. Sections of the left kidney showed extensive cloudy swelling of the tubules and glomeruli but no evidence of pyogenic infection.

Dog 5 The right ureter was transplanted August 2 1929. Due to the fact that the dog contracted distemper and was losing weight rapidly, she was anesthetized September 9, 32 days after operation in order to have a comparison of the two kidneys before death. There were no adhesions in the abdomen, and the anastomosis was perfectly healed. The right kidney was twice the size of the left, it was dark in color and showed many dilated veins over the surface. The right ureter was dilated to the size of a lead pencil. An opening was made in each ureter and catheters were introduced. About 75 cubic centimeters of cloudy urine, which showed pus IV were immediately obtained from the right kidney. Urine from the left kidney showed an occasional pus cell. Both right and left sides showed bacillus coli on culture. Functional test was unsatisfactory because of small amount of urine obtained.

The dog was killed with chloroform and the right kidney, ureter, and sigmoid were removed intact. The left kidney was also removed. A No. 4 ureteral catheter could not be passed down the ureter into the sigmoid as the opening in the mucous membrane had healed completely. The mucous membrane in area over end of catheter showed no rugae.

Microscopic section of the right kidney showed an inflammatory reaction throughout the pelvis and

cortex, with cellular infiltration. Some areas of the cortex contained small abscesses. Sections of the left kidney showed only cloudy swelling.

Dog 6 The right ureter was transplanted August 7, 1929. The dog recovered from the operation without incident and from then on never appeared to be sick and seemed well the day before death November 9, 94 days after operation.

At autopsy the operative wound was healed. The peritoneum was smooth and glistening and there was no fluid in the abdomen. The anastomosis was in good condition. The right kidney was very small about one half the size of the left. The right ureter was slightly larger than the left, and the right pelvis was slightly dilated. The right kidney, ureter and sigmoid were removed intact. The left kidney and a portion of the left ureter were also removed. The wall of the sigmoid was quite thin and no rugae were present. A small ureteral catheter passed down the ureter would not enter the sigmoid because opening had been closed by mucous membrane of bowel. There was no gross evidence of pus in either kidney.

Microscopic study of the right kidney showed the changes of acute inflammation, with cellular infiltration throughout. The left kidney showed only cloudy swelling.

Dog 7 The right ureter was transplanted August 13, 1929. The dog recovered nicely from the operation and was quite active for a month. She then began to refuse her food and looked sick. This downward course was progressive, and she died October 8, 56 days after operation.

At autopsy the operative scar was well healed. The abdomen was markedly distended. When the peritoneum was opened it was found to be flaming red and a large amount of blood tinged pus was seen to fill the entire abdomen. The right kidney was three times the size of the left. The upper pole was soft and necrotic, and fluid was seen to ooze out. The ureter was dilated about three times normal size. The right kidney, ureter, and a portion of the sigmoid were removed intact. The kidney was opened and found to be a mere shell. The cortex was perforated at the upper pole. A No. 6 catheter passed into the sigmoid without obstruction.

Microscopic study of the right kidney showed a dense infiltration with polymorphonuclear leucocytes throughout the whole organ. In one area a large blood clot was seen. Scattered areas of fibrous tissue formation were seen in the cortex. The left kidney showed a diffuse cloudy swelling.

Dog 8 The right ureter was transplanted August 19 1929. In this operation the catgut urine guide was not used. The dog progressed well for 1 month and then began to lose weight and strength. On October 14, 56 days after operation she was anesthetized in order to study the function of the kidneys and to obtain urine cultures. The previous operative scar was well healed, and the peritoneum was normal. There were many adhesions in the area of the ureteral anastomosis. Both kidneys were normal in size and color. The right ureter was dilated to the

size of a lead pencil. The ureters were opened and catheters tied in. Thick pus was obtained from the right side, but urine from the left kidney showed a very occasional pus cell. Cultures from both sides showed bacillus coli. A functional test was done. The dye appeared on the left side in 3 minutes in concentration IV, but no dye appeared on the right side in 30 minutes.

The dog was then killed with chloroform and the right kidney, ureter, and sigmoid were removed intact. The right kidney consisted of practically a mere shell of tissue. A small ureteral catheter passed down the ureter met obstruction just beneath the mucosa of the sigmoid and no opening could be demonstrated.

Microscopic sections of the right kidney showed a dense infiltration of leucocytes in the submucosa and mucosa of the pelvis. There were multiple abscesses in the cortex. The left kidney showed a lymphocytic invasion of the submucosa of the pelvis. There was no evidence of pyogenic infection elsewhere. There was a diffuse cloudy swelling.

Dog 17. The right ureter was transplanted September 18, 1929. The postoperative progress was uneventful for 1 month, and then she contracted mange which caused her to become quite weak and emaciated.

An attempt was made to anesthetize the animal November 25, 68 days after operation, but she died before urine specimens could be obtained. The peritoneum was normal, and there were no adhesions in the abdomen. The right kidney was one half the size of the left, and the right ureter was twice the size of the left. The pelvis of the kidney was not dilated and the lining was smooth and glistening. The right kidney and ureter were removed with the sigmoid. The right ureter was patent throughout except at the opening into the sigmoid, which was closed over by the mucous membrane of the bowel.

Microscopic sections of the right kidney showed a dense invasion of the submucosa of the pelvis with polymorphonuclear leucocytes and lymphocytes. There were no cellular products of inflammation in the cortex, which showed an extensive cloudy swelling. The left kidney showed no evidence of pyogenic infection but did show a marked cloudy swelling.

Although the Mayo catgut urine guide was used in all the cases except dog 8, the ureteral opening was closed by bowel mucosa in 5 of the 7 cases. It will be noted that this closure of the ureterosigmoidal opening occurred even in dog 1, which was killed on the seventh postoperative day.

In one (dog 7) the ureter was patent throughout, but the animal died from rupture of a pyonephrosis on the side of the transplanted ureter. The best result in the group seemed to be dog 4, in which there was no gross evidence of infection but the kidney was

quite small as compared with the side not operated upon. However, microscopic examination of this kidney showed marked fibrosis, cellular infiltration, and destruction of the glomeruli by fibrous tissue.

In only 2 cases in this group (dogs 5 and 8) were cultures taken from both kidneys just before death, and in each case the cultures showed a bacillus coli infection in the untransplanted as well as the transplanted side.

We did not obtain a satisfactory result in a single case in this group, the failure being attributed to closure of the ureterosigmoidal opening and to renal infection.

MAYO TECHNIQUE, BOTH URETERS TRANSPLANTED

In 3 animals both ureters were transplanted by the Mayo technique. Both ureters were transplanted at one operation in dog 26, and death occurred on the third day, apparently from uraemia. No autopsy was done. In dog 2 the left ureter was transplanted 16 days after the right. Death occurred 6 days after the second operation, due to a localized peritonitis resulting from soiling at the time of the second operation. In dog 3 the left ureter was transplanted 70 days after the right and death occurred 53 days later. Both ureters were open but stenosed, and cultures showed streptococci on the right and bacillus coli on the left. Complete reports of dogs 2 and 3 follow.

Dog 2. The right ureter was transplanted July 3, 1929. Recovery was uneventful and 16 days later the left ureter was transplanted. The dog never appeared well after the second operation and died July 25, 6 days after the second operation.

At autopsy the operative wound was not healed. A localized area of pus was found in the left lower quadrant. No pus and no signs of infection were found elsewhere in the abdominal cavity. The ureters and kidneys appeared normal in size. The right anastomosis was well healed, and the left showed some soft adhesions but no signs of urinary leakage. Both kidneys, both ureters, and the sigmoid were removed. The pelvis and ureters were not dilated and showed no gross pus. A No. 5 ureteral catheter would not pass through the ureterosigmoidal openings which were pin point in size.

Microscopic sections of the right kidney showed a marked inflammatory reaction, with cellular infiltration throughout the organ. The left kidney showed a mild inflammatory infiltration in the mucosa of the pelvis and a marked destruction of the tubules and glomeruli by cloudy swelling.

Dog 7 The right ureter was transplanted July 22, 1929. The dog seemed quite well and 70 days later the left ureter was transplanted. For about 6 weeks she was active but then began to become gradually weaker and refused to eat. She was anesthetized 53 days after the second operation in order to obtain urine cultures before death. The peritoneum was smooth and glistening. Both kidneys were enormously enlarged and both ureters were dilated and kinked. The anastomosis appeared normal. Ureteral catheters were tied in the ureters and cultures obtained which showed streptococci on the right side and bacillus coli on the left side. Both sides showed much pus. The dog was killed and both kidneys and ureters were removed with the sigmoid. The ureterosigmoidal openings were patent but markedly stenosed.

Microscopic sections of the right kidney showed an extensive inflammatory reaction throughout the pelvis and cortex. The left kidney showed no cellular infiltration but there was a marked congestion with hemorrhage and an extensive destruction of the tubular epithelium by cloudy swelling.

The results in these 2 cases were obviously poor. Marked infection occurred in all four kidneys as was demonstrated by the microscopic sections. The pathological picture is essentially the same as was seen in the unilateral Mayo transplants.

COFFEY TECHNIQUE, BOTH URETERS TRANSPLANTED

In 8 animals, dogs 9, 10, 12, 13, 14, 21, 22, and 24, both ureters were transplanted at the same time by the Coffey tube technique. They lived from 7 to 31 days. The complete records of these 8 dogs are given below.

Dog 9 Both ureters were transplanted September 6, 1929. Following the operation the dog was quite sick for a few days and the ends of the catheters had to be cut frequently to keep them draining. The first catheter came out on the ninth and the second came away on the tenth postoperative day. The stools were liquid from that time on. During the next week the dog appeared quite normal. She then began to lose weight quite rapidly and continued to marked emaciation. On October 6, 30 days after operation the animal's condition was very poor, so anesthesia was started in order to do functional tests and obtain urine cultures, but she died before the abdomen was opened.

At autopsy the peritoneum was smooth and glistening. There were a few adhesions in the lower abdomen. The right kidney appeared to be slightly enlarged, and the right ureter was larger than normal. The left kidney was three times the size of the right. There were many engorged vessels over its surface. On gross section this kidney showed a large

hydronephrosis, the renal parenchyma being reduced to a mere shell in which the normal markings were obscured. The left ureter was also about three times as large as the right and showed a kink in the lower third. Catheters passed down both ureters entered the sigmoid without obstruction.

Microscopic sections of the right kidney showed an extensive edema throughout, with destruction of the tubular epithelium. There were many small cysts formed by rupture of the tubules. There were no cellular products of inflammation. The left kidney showed many small cysts in the cortex and the blood vessels were dilated and full of blood. There was an extensive cloudy swelling. There was no evidence of pyogenic infection.

Dog 10 Both ureters were transplanted September 16, 1929, and 5 days later both catheters came out. Up until this time and for 24 hours afterward the dog appeared well and the stools were liquid. On September 22 the dog appeared quite sick, and there was a purulent exudate from both eyes. Death occurred on the afternoon of September 23, 7 days after operation.

At autopsy the operative wound was not healed. There was free fluid in the abdomen and much pus in the pelvis as well as along the course of the left ureter. The ureters were not dilated. The right kidney was about twice the normal size and showed a reddish color. The left kidney was normal in size and color. The left anastomosis showed a partial separation from the sigmoid but the right was in good condition. Catheters passed down both ureters entered the sigmoid without obstruction.

Microscopic section of the right kidney showed complete destruction of kidney tissue throughout with multiple abscesses. The left kidney showed no evidence of pyogenic infection but there was a marked destruction of the tubular epithelium and the glomeruli by cloudy swelling.

Dog 12 Both ureters were transplanted September 19, 1929. At the time of operation it was noted that the dog was pregnant. Two days after operation the catheters came away. The condition of the dog seemed good and the stools were liquid. On September 25 the operative wound broke open and a small knuckle of gut protruded. Within a few minutes the dog was anesthetized and a secondary closure of the abdominal wound was done. The dog died 7 days after operation.

At autopsy there was a large amount of free pus in the abdomen. The intestines were matted together. The right kidney was slightly larger than normal and the left was normal in size. The ureters were not dilated. The kidneys and ureters were removed with the sigmoid attached. The kidneys showed some congestion but no microscopic pus. The anastomoses were healed. Catheters passed down both ureters entered the bowel without obstruction.

Microscopic section of the right kidney showed an inflammatory reaction, with a lymphocytic infiltration beneath the mucosa of the pelvis. The remainder of the kidney showed destruction by cloudy swell-

ing. The left kidney showed characteristic cloudy swelling. The blood vessels were dilated and full of blood. No evidences of pyogenic infection.

Dog 13 Both ureters were transplanted October 9, 1929. The non protein nitrogen taken at the time of operation was 35 milligrams. Urine cultures from both sides were sterile. Following operation the dog failed to eat and showed a progressive downward course. Catheters came away on the third and fourth postoperative days. On the fourteenth postoperative day the non protein nitrogen was 138 milligrams and on the twenty-first postoperative day the non-protein nitrogen was 113 milligrams. Death occurred on the thirty first postoperative day.

At autopsy the operative wound was well healed. The peritoneum was smooth and glistening. The right kidney and ureter were normal in size. The left kidney and ureter were slightly dilated. The left ureter showed two kinks due to adhesions. Both anastomoses showed that the sutures in the muscularis had pulled out so that the mucosa of the sigmoid was exposed and no valve action obtained. Catheters passed down both ureters entered the bowel but there was a slight stenosis of the left ureterosigmoidal opening. On gross section both kidneys were seen to contain pus.

Microscopic sections showed small abscesses throughout the cortex. In several areas the capsular spaces showed an accumulation of albuminous material. The left kidney appeared as did the right.

Dog 14 Both ureters were transplanted October 11, 1929. Following operation, the dog showed a progressive downward course. One catheter came away in 12 hours, and the second catheter came away after 2 days. Eighteen days after operation the non protein nitrogen was 146 milligrams. Death occurred October 30, 19 days after operation, at which time the dog was markedly emaciated and showed a bilateral purulent conjunctivitis.

At autopsy the peritoneum was smooth and glistening. There were a few adhesions around the urinary bladder. Both anastomoses were well healed, and the left kidney and ureter were normal in size. The right kidney was somewhat smaller, and the right ureter was not dilated. A catheter passed down the left ureter entered the sigmoid without obstruction. A catheter passed down the right ureter would not enter the sigmoid, as the ureterosigmoidal opening was covered over by mucosa of the bowel.

Microscopic sections of the right kidney showed a diffuse acute inflammatory reaction in the cortex. There were many small abscesses in the mucosa and submucosa of the pelvis. The left kidney showed only one area in which there was an inflammatory reaction, and this was around a fibrous glomerulus.

Dog 21 Both ureters were transplanted December 2, 1929. After operation the dog showed a progressive downward course. Both catheters came out on the twelfth day, and death occurred on the seventh postoperative day.

At autopsy a small superficial abscess was found in the operative wound. The peritoneum, however,

was smooth and glistening. The right kidney was somewhat smaller than the left, and the lower pole showed an area of dark discoloration. The ureter was not dilated. On gross section free pus was found in the pelvis, but the cortical and medullary markings were normal. There were infarcts in the upper and lower poles. The right anastomosis was normal, and a catheter passed down the ureter entered the bowel without obstruction. The left kidney was slightly larger than the right, and the pelvis contained frank pus. The cortical and medullary markings were distinct, and the pelvis was not dilated. The left ureter was normal in size and patent throughout. The left anastomosis was well healed.

Microscopic sections of the right kidney showed no evidence of pyogenic infection. The left kidney showed a cellular infiltration beneath the mucosa of the pelvis and polymorphonuclear leucocytes were seen scattered through the cortex. Some of the glomeruli were replaced by fibrous tissue. Both kidneys showed marked evidence of cloudy swelling.

Dog 22 Both ureters were transplanted December 9, 1929. The postoperative non protein nitrogen was 40 milligrams and cultures of the urine taken at the time of operation were sterile. Both catheters came out on the fifth day. The dog showed a progressive downward course after operation. Shortly before death the non protein nitrogen was 98 milligrams. The dog was killed on the tenth postoperative day because of poor general condition.

At autopsy the operative wound was slightly infected. The peritoneum, however, was smooth and glistening, and there were no adhesions in the abdomen. The right kidney was about three times normal size and quite dark in color. The right ureter was also dilated. The left kidney and ureter were slightly larger than normal. On gross section the parenchyma of the right kidney was soft and hemorrhagic throughout, and the cortical and medullary markings were obliterated. The pelvis was dilated and full of pus. The right anastomosis was well healed, and a catheter passed down the ureter entered the bowel without obstruction. On gross section the left kidney showed normal markings, and the pelvis was not dilated but contained frank pus. The left anastomosis was well healed. A catheter passed down the left ureter entered the bowel without obstruction. The intrasigmoidal portion of the left ureter had not sloughed off.

Microscopic sections of the right kidney showed a diffuse cellular infiltration, with abscess formation in the cortex. The left kidney showed a generalized inflammatory reaction but no abscesses.

Dog 24 Both ureters were transplanted December 16, 1929. Following operation the dog showed marked loss of weight and refused to eat. Both catheters came away on the fifth day. Urine cultures taken at the time of operation were sterile, and the non protein nitrogen was 27 milligrams. The animal died 10 days after operation.

At autopsy the operative wound showed a small abscess. The peritoneum, however, was smooth and

glistening. There were no adhesions in the abdomen. The left kidney was enlarged about three times normal size and was soft and fluctuant. On section a large amount of turbid urine escaped and the pelvis seemed to be markedly dilated. The cortex of the left kidney was quite thin, but the markings were distinct. The left ureter was correspondingly dilated. The right kidney was enlarged about twice the normal size and on section was found to contain a large amount of yellowish purulent material. The cortical markings were indistinct and the pelvis was dilated and showed an exudate on its surface. The right anastomosis was well healed. The left anastomosis showed infection in the lower portion. Both uretersigmoidal openings were stenosed so that No. 6 catheters were passed with difficulty.

Microscopic sections of both kidneys showed extensive infection throughout. Much hemorrhage and a few infarcts were found beneath the capsule.

In 4 dogs of the above group, dogs 13, 14, 22, and 24, we were able to demonstrate histological evidence of bilateral renal infection. Three dogs, 10, 12, and 21, showed infection in only one side, and in one animal, dog 9, we were unable to find microscopic evidence of pyogenic infection. However, dog 9 showed a large hydronephrosis with parenchymal degeneration.

Complete closure of the uretersigmoidal opening occurred in only one ureter, dog 14, and in this animal one catheter was pulled out a few hours after operation. The 2 cases, dogs 13 and 24, in which the ureteral openings were stenosed, showed an extensive infection in both kidneys. A completely normal kidney was not seen in the entire group, although five kidneys failed to show microscopic evidence of pyogenic infection.

COFFEY TECHNIQUE, ONE URETER TRANSPLANTED

In two dogs, numbers 15 and 16, a single ureter was transplanted by the Coffey technique. The results in these two operations were better than we had obtained in any of the groups thus far studied. The dogs lived for 76 and 87 days, and at autopsy there was no macroscopic evidence of disease in the urinary tract. Microscopic study showed no evidence of pyogenic infection. Apparently these were successful transplants, but the dogs did not ever appear well after being operated upon.

Dog 15 The right ureter was transplanted October 30, 1929. The catheter came out on the second day. The dog refused to eat for 2 weeks before death. She had appeared well up until that time except for loss of weight. Death occurred January 14, 1930, 76 days after operation.

At autopsy the peritoneum was smooth and glistening. There were a few adhesions around the bladder. Both kidneys were of the same size and color. On gross section the right kidney showed no evidence of infection. The right ureter was of normal size, and a catheter passed down the ureter entered the bowel without obstruction. The anastomosis was in good condition.

On microscopic section there was no inflammatory reaction in either kidney. Both kidneys showed some cloudy swelling.

Dog 16 The right ureter was transplanted November 6, 1929. The catheter came out on the thirteenth day. The animal never appeared quite normal after the operation and steadily lost weight. About 1 month after operation she contracted mange, for which she had to be killed February 5, 1930, 87 days after operation.

After anesthesia was started but the dog promptly died. There were no signs of peritonitis. The kidneys were of equal size and color. The transplanted ureter was not dilated and a catheter passed down it entered the bowel without obstruction. The anastomosis was in excellent condition. On gross section there was practically no difference between the transplanted and the untransplanted sides.

On microscopic section there was no inflammatory reaction in either kidney. Both kidneys showed some cloudy swelling.

In comparing the results of the Mayo and Coffey operations in dogs, some difference is noted in so far as infection is concerned. The microscopic sections of the kidneys operated upon by the Coffey technique showed less evidence of pyogenic infection, but the dogs were all definitely sick after transplantation was done. Obviously the best results were obtained by the Coffey technique, in which only one ureter was transplanted. The troublesome ureteral stenosis so often mentioned by workers in this field seems to be largely obviated by the use of the ureteral catheters.

The high incidence of postoperative renal infections led to considerable speculation as to the manner in which the kidney becomes involved. Close observation of a recent clinical case suggested to us that infection may reach the kidney by means other than the lumen of the ureter, as shown in the following case.

A boy, aged 10 years, was admitted to the hospital November 7, 1929, with exstrophy of the urinary

bladder. Pre-operative studies showed an uninfected urinary tract and the non protein nitrogen was 35.6 milligrams. He was operated upon December 3, 1929, and both ureters were implanted in the sigmoid by the Coffey tube technique. No 8 ureteral catheters were used and urine drained well during and after the operation. The ends of the catheters were placed in sterile bottles covered with sterile corks. Each time the bottles were emptied fresh sterile bottles were used. The immediate postoperative convalescence was uneventful except for marked abdominal distention, which was finally relieved by irrigation through a rectal tube. Four days after operation urine from the right and left catheters showed 1 to 3 pus cells per field. Seven days after operation urine from the right catheter showed 1 to 3 pus cells per field, and urine from the left catheter showed 15 to 30 pus cells per field. Nine days after operation the right side showed 5 to 10 pus cells per field and the left 20 to 40. Eleven days after operation both sides showed pus cells too numerous to count, and culture of the urine showed streptococci and bacillus coli. The left catheter came out 11 days and the right catheter came out 17 days after operation. Shortly before the catheters came away the non protein nitrogen was 33 milligrams, and 3 days after the last catheter came out the non protein nitrogen was 65.6. Three days later it had dropped to 34 milligrams. About 48 hours after the second catheter came away, the patient developed a sharp rise in temperature, which reached 105 degrees. At the same time localized tenderness was noted in the left costovertebral angle, which persisted for several days. After 4 days the temperature returned to normal and remained there. The patient's recovery was delayed by a low grade wound infection. He was discharged January 26, 1930, at which time he could retain his urine for as long as 6 hours. His general condition was excellent, and a letter from his mother April 10, 1930, says that he is now enjoying excellent health. He is to return in a few months for removal of the bladder.

The beginning and the progressive increase of the infection while the catheters were in place and amply protected, we believe, offers a strong argument against renal infection ascending the lumen of the ureter in this case.

TRANSPLANTATION OF LIGATED URETERS

In an attempt to study the question of renal infection, four groups of experiments were done on 8 dogs.

The right ureters were doubly ligated with linen in the first group, dogs 17 and 18, and the ureters transplanted by the Mayo technique. Urine collected from the right kidneys at the time of operation was sterile. Complete records of the 2 dogs in group 1 follow.

Dog 17 was operated upon November 8, 1929, and she was anesthetized for study 7 days later. There was no peritonitis but a few adhesions were found in the region of the anastomosis. The right ureter was dilated to about three times the normal size. On pulling aside the gut, a large amount of free pus was found in the right perirenal area. Culture of this pus showed streptococci. The left kidney and ureter appeared normal. Urine from the right kidney showed bacillus coli and many pus cells. The dog was then killed with chloroform, and the upper pole of the right kidney was found to be adherent to the liver. The right kidney was three times the size of the left, was dark in color, and showed a large number of engorged vessels over the surface. On gross section the left kidney appeared entirely normal. On gross section the right kidney showed a marked thickening of both the cortex and medulla, with a loss of all normal markings. At the lower pole was a subcortical abscess about 4 centimeters in diameter, and in the upper pole there was another subcortical abscess about 2 centimeters in diameter. A No. 4 catheter passed down the right ureter entered the sigmoid without obstruction.

Microscopic sections of the right kidney showed an extensive inflammatory exudate throughout the substance of the kidney. The left kidney showed the changes of cloudy swelling. There was no evidence of pyogenic infection.

Dog 18 was operated upon November 22, 1929, and anesthetized for study 3 days later. There was a localized abscess at the site of the previous incision. The pelvic peritoneum was inflamed, and there was a suppurative process at the site of the anastomosis with many adhesions in this area. Urine taken from the right kidney showed bacillus coli. The dog was then killed with chloroform. The right kidney was slightly larger than the left, but the ureter was normal in size. The left kidney appeared entirely normal. A catheter passed down the right ureter did not enter the sigmoid, as the ureter was still firmly ligated. The sutures at the site of anastomosis had sloughed out and free pus was found in this area. On gross section the right kidney showed a reddish discoloration of the medulla and cortex, although the parenchymal markings were distinct. There was a slight hydronephrosis, and the pelvis contained microscopic pus.

Microscopic sections of the right kidney showed an acute inflammatory reaction in the pelvis, with abscess formation beneath the mucosa. The left kidney showed no evidence of pyogenic infection.

Right renal infection was demonstrated in both dogs of this group. In one, dog 17, the ureter was patent and no opinion can be given as to the manner in which the kidney became infected. However, in dog 18 the ureter was still firmly ligated, which would indicate that the lumen of the ureter could not have transmitted the infection.

In the second group, dogs 19 and 20, of these experimental operations, we made an effort to protect the end of the ureter. In this group the right ureter was doubly ligated with linen and a small opening was made in the mucosa as for a transplant so that the end of the ureter was potentially infected. This opening in the mucosa was then closed with fine catgut and the ureter implanted between the mucosal and muscular layers of the sigmoid. Urine from the right kidney was sterile in each case. The complete records of the 2 dogs in group 2 are given below.

Dog 19 was operated upon November 25, 1930, and was anesthetized for study 8 days later. The operative wound showed a low grade infection, but the peritoneum was normal. There were a few adhesions in the region of the anastomosis. Culture obtained from the right kidney showed diphtheroid bacilli. The right kidney was slightly larger than the left and showed many engorged vessels over its surface. The right ureter did not appear dilated. On cut section the right kidney showed normal markings but the pelvis was slightly dilated. There was no gross evidence of infection. A No. 14 catheter passed down the right ureter entered the bowel without obstruction.

Microscopic sections of the right and left kidneys showed no evidence of pyogenic infection. There was some destruction in the tubular epithelium due to cloudy swelling.

Dog 20 was operated upon November 20, 1930, and anesthetized for study 8 days later. There was a low grade wound infection. The abdominal cavity was clean. There was a mass of adhesions in the lower abdomen in the area of anastomosis. Urine obtained from the right kidney for culture showed bacillus coli and streptococci. The right kidney was normal in size but was soft and fluctuant throughout. On gross section the right kidney showed clear urine in the pelvis which was not dilated. The parenchyma was normal in color and thickness. The markings were distinct. The ureter was of uniform thickness and not dilated. A catheter passed down the right ureter entered the bowel without obstruction.

Microscopic sections of the right kidney showed small areas of cellular infiltration beneath the submucosa of the pelvis. The left kidney showed no inflammatory changes.

In both animals of group 2 the patency of the ureter was found to have been re-established at the time of autopsy. Neither kidney was infected in dog 19, and in dog 20 the right kidney was only mildly infected as shown by the microscopic slides. Better kidneys were found in group 2, dogs 19 and 20,

than in group 1, dogs 17 and 18. We attributed this fact to the delayed exposure of the end of the ureter to infected bowel contents. Again we believed we had obtained results which indicated that the lumen of the ureter was not the transporting agent for renal infection in these cases.

In group 3, dog 25, the right ureter was ligated and transplanted between the mucosa and muscularis without making an opening in the mucosa. Urine taken from the right kidney at the time of operation was sterile. Even though the end of the ureter was ligated and not exposed to infectious material, the right kidney showed a marked inflammatory reaction after 9 days. The complete record of dog 25 is given below.

Dog 25 was operated upon December 18, 1930, and anesthetized for study 9 days later. The peritoneum was normal. The right kidney was twice the size of the left and showed many large veins over its surface. Culture obtained from the right kidney showed staphylococci. On section, thin bloody fluid escaped from the pelvis. The parenchyma was of normal thickness and the markings were distinct. The right ureter was twice the size of the left. The anastomosis was well healed. A catheter passed down the right ureter failed to demonstrate an opening in the mucosa.

Microscopic sections of the right kidney showed a heavy leucocytic infiltration throughout. There was a great deal of hemorrhage. The left kidney showed no evidence of pyogenic infection but the epithelium of the tubules was destroyed by cloudy swelling.

The tendency for the re-establishment of drainage in groups 1 and 2 of these experimental operations suggested to us that we might decrease the period of obstruction in the ureter and obtain even better results. So in group 4, dogs 27, 28, and 29, the right ureter was ligated with No. 1 plain catgut and transplanted by the Mayo technique. In each case sterile urine was obtained at operation. These dogs were allowed to live 15, 23, and 25 days so that the pathological changes, if any, would be well developed. The complete records of group 4 are given below.

Dog 27 was operated upon February 24, 1930. The postoperative course was uneventful except for some loss of weight. The animal was anesthetized 15 days after operation and urine obtained from the right kidney for culture showed streptococci and bacillus coli. The peritoneum was smooth and glistening throughout. There were a few adhesions in

the region of the anastomosis. There was a small localized abscess in the retroperitoneal area at the site where it had been opened to liberate the ureter at the time of the original operation. The right kidney was slightly larger than the left, otherwise they both appeared normal. The right ureter was twice the size of the left. On section the right kidney showed no gross pathological changes. A catheter passed down the right ureter entered the sigmoid without difficulty. There was a small abscess in the wall of the sigmoid where it had been penetrated by the retention suture.

Microscopic sections of the right kidney showed a few small areas of cellular infiltration near the pelvis, otherwise the kidney showed only the changes of cloudy swelling. The left kidney showed a marked inflammatory reaction with abscesses throughout the cortex.

Dog 28 was operated upon February 27, 1930 and the postoperative course was normal. She was anesthetized for study 25 days after operation. The abdominal cavity was clean. The large bowel was slightly adherent to the bladder. The anastomosis was well healed, and urine obtained from the right kidney showed staphylococci which was thought to be a contamination, as the microscopic examination of urine showed only a very occasional pus cell. Grossly, the right kidney showed no changes from the left. A catheter passed down the right ureter entered the bowel without obstruction.

Microscopic sections of the right and left kidneys showed no evidence of inflammatory reaction. The changes of cloudy swelling were present in both.

Dog 29 was operated upon March 3, 1930 and the postoperative convalescence was uneventful. The animal was anesthetized for study 23 days after operation. There was a slight wound infection but the peritoneum was smooth and glistening. There were a few adhesions in the area of anastomosis. The right kidney appeared smaller than the left. Urine obtained from the right kidney for culture was sterile. On gross section the right kidney showed a few areas of ecchymosis in the cortex and medulla. The pelvis was of normal size. A catheter passed down the right ureter entered the bowel without obstruction.

Microscopic sections of the right kidney showed a marked inflammatory reaction throughout, with abscess formation. The left kidney showed a cellular infiltration beneath the mucosa of the pelvis.

In all 3 cases of group 4, the right ureter was patent throughout at autopsy. Two dogs, 27 and 29, developed a bilateral renal infection, and only one, dog 28, showed uninfected kidneys on microscopic examination. The results in this group were indicative of the value of protection to the end of the ureter and the possibility of using some type of obstruction to obtain this protection.

SUMMARY

In our hands the transplantation of the ureters to the sigmoid in dogs is highly unsatisfactory by the Mayo technique. In every case the kidney became infected and closure of the ureterosigmoidal opening by the mucosa of the bowel occurred in 5 of the 7 unilateral transplants. In the 2 bilateral transplants the ureteral openings were markedly stenosed.

The completed Coffey technique gave slightly better results. Of the 8 dogs, 4 showed bilateral infection, 3 showed infection in only one side, and 1 showed no evidence of infection but was hydronephrotic on one side. Complete closure of the ureteral opening occurred in only one ureter.

The unilateral Coffey operations revealed kidneys in which there was no microscopic evidence of pyogenic infection, yet the dogs never appeared well after operation.

Believing that the kidneys became infected by means other than the lumen of the ureter, we obtained infected kidneys in 2 cases in which the ureters were still completely obstructed at autopsy. The lymphatics must be given serious consideration as a means of transmitting infection to the kidneys. A clinical case showed the infection to begin while the catheters were still in the lumen of the ureters. The excellent work of Sweet and Stewart describes the lymphatic route.

Solution of the problem of preventing ascending renal infection probably depends upon the discovery of means to prevent infection through the lymphatics. Partial success in this direction was obtained in our experimental cases in which we tried to protect the exposed end of the ureter for a time from infected material. These results suggest that a new technique for transplantation with this principle in view might lessen the tendency to renal infection.

Both Coffey and Kirwin have recently described new techniques whereby the end of the transplanted ureter is protected. In a personal communication Coffey states that his results in dogs with this new technique indicate that it may supersede his tube technique when single ureters are transplanted.

Until a uniformly successful procedure is evolved, it would seem the better surgical

changes of the uterine mucosa, as well as in the regulation of menstrual periodicity has held sway for a long period of time. In a paper read abroad before a gynecological society in 1923, the writer pointed out that the bulk of evidence obtained both by experimental study and clinical observation strongly suggests that the regulation of ovarian periodicity and of menstrual rhythm is controlled by the anterior lobe of the pituitary and a correlated hypothalamic center. Without going into the details, it will suffice to indicate here the principal points. A subtle reciprocal relationship between the anterior pituitary and the ovarian follicles can be established by showing that the follicular fluid acts as a stimulus on the pituitary, which in turn initiates and promotes the ripening of follicles. In the light of these views, the cyclic endocrine activity of the two organs may be brought into consonance, and an acceptable explanation may be offered for the occurrence of rhythmical changes in the uterine mucosa. Zondek, in a recent paper, fully corroborates this conception.

With this phase of our knowledge of sex physiology established, the next obvious step was to learn whether it would be possible to produce in experimental animals an exaggeration of the proliferative phenomena which normally occur in the uterine mucosa during prooestrus by the daily administration of pituitary substance over a prolonged period of time. Guinea pigs were chosen for these experiments since accurate data concerning the structure of the mucosa in the various stages of the cycle in this species have been established by the exhaustive studies of Stockard. Furthermore, the similarity in structure of the endometrium in that animal and in woman, made it appear possible that results obtained in the one might be transferred to the other without too great stretch of the imagination.

The growth promoting principle of the anterior lobe obtained from alkaline extracts of pituitary glands of beef prepared according to Evans' method has been used in the majority of the experiments, while a few animals were treated with acid extracts of the gland. In a third series of experiments bits of fresh an-

terior lobe were transplanted into the musculature of the thigh.¹ The extracts were injected intraperitoneally for 12 successive days, 1 cubic centimeter being the standard dose, while two transplantations were made during the course of 19 days. The animals were sacrificed on the thirteenth day in the former group and on the twentieth day in the latter.

Upon gross examination, the most noticeable feature in the uterus consisted in a considerable increase in circumference attended with a purple bluish discoloration. Another change consisted in the readiness of the uterus to contract, as manifested by the occurrence of peristaltic contractions which persisted after the animals had been killed. Of first importance among the data obtained on microscopic study of the thickened uterine mucosa is the fact that a striking increase of the connective tissue has taken place, its elements appearing definitely enlarged and at the same time more abundant. While this phenomenon is obvious in the entire mucosa, the increase of the interstitial tissue is most pronounced in its basal layer, which is considerably augmented in height and also in density. In the upper two thirds of the mucosa the glands are conspicuous by their great number. Their active proliferation is readily recognizable, as they have become greatly lengthened, more tortuous and occasionally branching. Cystic dilatation of the glands may be distinguished here and there in the middle layer of the mucosa. This occurred in quite a number of instances in the first group, but was most marked in animals which were treated by the method of transplantation. The histological findings may be best demonstrated by photomicrographs, when it will be seen that Figure 3 bears a close resemblance to the "Swiss cheese pattern" of hyperplastic endometrium, as depicted by Novak.

The epithelium of the glands is of the high columnar type with no indication of secretion whatsoever. When the glands have become dilated the epithelium may be seen flattened. Extensive dilatation and engorgement of capillaries and also of vessels of a larger caliber are seen both in the uterine wall and in the

¹Twenty-four animals were treated with the alkaline extract, 4 with the acid extract, while transplantations were made in 28 additional animals.

the region of the anastomosis. There was a small localized abscess in the retroperitoneal area at the site where it had been opened to liberate the ureter at the time of the original operation. The right kidney was slightly larger than the left, otherwise they both appeared normal. The right ureter was twice the size of the left. On section the right kidney showed no gross pathological changes. A catheter passed down the right ureter entered the sigmoid without difficulty. There was a small abscess in the wall of the sigmoid where it had been penetrated by the retention suture.

Microscopic sections of the right kidney showed a few small areas of cellular infiltration near the pelvis, otherwise the kidney showed only the changes of cloudy swelling. The left kidney showed a marked inflammatory reaction with abscesses throughout the cortex.

Dog 28 was operated upon February 27, 1930, and the postoperative course was normal. She was anesthetized for study 25 days after operation. The abdominal cavity was clean. The large bowel was slightly adherent to the bladder. The anastomosis was well healed, and urine obtained from the right kidney showed staphylococci, which was thought to be a contamination, as the microscopic examination of urine showed only a very occasional pus cell. Grossly, the right kidney showed no changes from the left. A catheter passed down the right ureter entered the bowel without obstruction.

Microscopic sections of the right and left kidneys showed no evidence of inflammatory reaction. The changes of cloudy swelling were present in both.

Dog 29 was operated upon March 3, 1930, and the postoperative convalescence was uneventful. The animal was anesthetized for study 23 days after operation. There was a slight wound infection but the peritoneum was smooth and glistening. There were a few adhesions in the area of anastomosis. The right kidney appeared smaller than the left. Urine obtained from the right kidney for culture was sterile. On gross section the right kidney showed a few areas of ecchymosis in the cortex and medulla. The pelvis was of normal size. A catheter passed down the right ureter entered the bowel without obstruction.

Microscopic sections of the right kidney showed a marked inflammatory reaction throughout, with abscess formation. The left kidney showed a cellular infiltration beneath the mucosa of the pelvis.

In all 3 cases of group 4, the right ureter was patent throughout at autopsy. Two dogs, 27 and 29, developed a bilateral renal infection, and only one, dog 28, showed uninfected kidneys on microscopic examination. The results in this group were indicative of the value of protection to the end of the ureter and the possibility of using some type of obstruction to obtain this protection.

SUMMARY

In our hands the transplantation of the ureters to the sigmoid in dogs is highly unsatisfactory by the Mayo technique. In every case the kidney became infected and closure of the ureterosigmoidal opening by the mucosa of the bowel occurred in 5 of the 7 unilateral transplants. In the 2 bilateral transplants the ureteral openings were markedly stenosed.

The completed Coffey technique gave slightly better results. Of the 8 dogs, 4 showed bilateral infection, 3 showed infection in only one side, and 1 showed no evidence of infection but was hydronephrotic on one side. Complete closure of the ureteral opening occurred in only one ureter.

The unilateral Coffey operations revealed kidneys in which there was no microscopic evidence of pyogenic infection, yet the dogs never appeared well after operation.

Believing that the kidneys became infected by means other than the lumen of the ureter, we obtained infected kidneys in 2 cases in which the ureters were still completely obstructed at autopsy. The lymphatics must be given serious consideration as a means of transmitting infection to the kidneys. A clinical case showed the infection to begin while the catheters were still in the lumen of the ureters. The excellent work of Sweet and Stewart describes the lymphatic route.

Solution of the problem of preventing ascending renal infection probably depends upon the discovery of means to prevent infection through the lymphatics. Partial success in this direction was obtained in our experimental cases in which we tried to protect the exposed end of the ureter for a time from infected material. These results suggest that a new technique for transplantation with this principle in view might lessen the tendency to renal infection.

Both Coffey and Kirwin have recently described new techniques whereby the end of the transplanted ureter is protected. In a personal communication Coffey states that his results in dogs with this new technique indicate that it may supersede his tube technique when single ureters are transplanted.

Until a uniformly successful procedure is evolved, it would seem the better surgical

judgment to use ureteral transplantation only in those cases in which older and better understood methods are impossible

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CONCERNING THE ETIOLOGY OF HYPERPLASIA OF THE ENDOMETRIUM

J. HOFBAUER, M.D., F.A.C.S., BALTIMORE, MARYLAND

From the Department of Obstetrics, Johns Hopkins University and Hospital

IN the realm of pathological endometrial conditions, hyperplasia of the endometrium, owing to its frequency as well as to its relation to functional uterine hemorrhage, occupies a singular position. The study of this histological and clinical entity has been the subject of numerous investigations ever since Olshausen in 1878 focused the attention of gynecologists on the correlation between long continued uterine hemorrhages with a conspicuous thickening of the endometrium, which he described in detail and designated as endometritis fungosa or chronic hyperplastic endometritis. The subsequent researches of German authors (Franz, Buettner, Seitz, Schroeder, R. Meyer), as well as the recent studies of Shaw in England, and notably the work of Cullen, Novak and Mertzloff in this country, have been of importance in establishing the anatomical findings in the condition of the endometrium under consideration.

The nature of hyperplasia of the endometrium is that of an overgrowth of its constituents, both epithelial elements and stroma. The endometrial overgrowth is evident on gross examination, which reveals a definitely thickened mucosa, occasionally as much as a centimeter and a half in diameter. When the

process is pronounced, the endometrium is thrown into folds which may form polypoid protrusions into the uterine cavity, the condition then being called polypoid endometrial hypertrophy. The proliferative activity of the epithelial elements, as well as of the stroma constitutes the characteristic feature of a more or less distinctive histological picture, with slight individual variations in certain instances. The stroma is excessive in amount and shows an abundance of cellular elements. It may be dense or somewhat edematous, the latter being particularly noticeable in the proximity of areas of disintegration. The blood vessels are often distended and there may be extravasation of blood into the superficial layer of the mucosa beneath the epithelium. Here and there a thrombosed vessel may be seen. Hyperemia of the entire endometrium is essentially due to a marked dilatation of the capillaries. On the other hand, the most specific histological feature of hyperplasia of the endometrium consists in the characteristic gland pattern. The glands are increased in number, and in places are thickly crowded together, some of them are small, while the majority appear enlarged. The glands are lengthened and have assumed a

tortuous appearance. Sometimes they branch, but they never invade the muscle wall of the uterus. Dilatation of the glands occurs quite commonly, cystically dilated glands being found chiefly in the middle zone of the endometrium. Novak, and recently Schroeder and Shaw also, attach great importance to this phenomenon, claiming that the "Swiss cheese pattern" of the endometrium should be considered a significant feature of the condition in question. The glandular epithelium is of the high columnar type with no suggestion of secretory activity. At times it presents a double row of elements, which occasionally may resemble the conditions found in the beginning of an adenocarcinoma. When the glands have become markedly distended, the lining epithelium is correspondingly flattened out. A lymphocytic infiltration of the superficial layer of the endometrium is sometimes noticeable in the small areas of disintegration.

For years, hyperplasia of the endometrium has been correlated with ovarian disorder, the true nature of which was obscure. Since recurrence of hyperplasia is frequently noted after repeated curettage, persistence of ovarian dysfunction has been invoked to account for the clinical observation. Small cystic follicular atresia with absence of luteal tissue is said by Schroeder to be the characteristic finding, and he regards the anatomical changes in the uterus as secondary to the ovarian pathology. Hence, the terms *ovariopathia hæmorrhagica* or *hyperplasia endometri ovarialis* were suggested by him in order to cover both the clinical and anatomical features of the condition. Schroeder argues that the primary phenomenon consists in an increased number of maturing follicles, the great majority of which deteriorate and form small cysts. It is the persistence of a prolonged period of maturation of follicles which, according to his reasoning, characterizes the abnormal ovarian activity, and in turn accounts for the pathological proliferation of the endometrial constituents—connective tissue and epithelium. Owing to the fact that atresia of follicles is attended with a certain amount of secretion, small cysts may develop in the course of time. However, what causes the cystic degeneration of the ovaries

is at present still a matter of mere speculation. Disturbances of circulation, such as repeated or continuous hyperemia, with or without inflammatory processes are considered by some writers to be at the basis of the problem. Beyond the demonstration that hyperplasia of the endometrium may follow repeated abortions, or pelvic inflammation, or uterine misplacements, there is no definite proof of an interrelationship between prolonged hyperemia or passive congestion of the genital organs on one hand and cystic degeneration of the ovary on the other. There have been indications of late that hyperplasia of the endometrium may be associated with granulosa cell tumor of the ovary or may result from non-gratified sexual desire.

Because of our present defective knowledge of the actual cause of hyperplasia of the endometrium, an endocrine disorder affecting the ovary primarily or secondarily has been considered by some investigators. Novak writes "In view of the probability of hyperplasia being an anatomical expression of an endocrine disorder, it was of interest to search for endocrine symptoms in our patients. In no case was any note made of thyroid symptoms, either of hypothyroidism or hyperthyroidism." Shaw remarks "It is difficult to believe that the stimulus is exerted by the ovaries, for the latter are relatively inactive. The uterine hyperplasia is controlled by some other factor reaching the uterus independently of the ovaries." Yet, no definite interdependence of any endocrine factor with the causation of either cystic ovaries or anatomical changes in the uterine mucosa has hitherto been demonstrated.

There is no denying the dictum that an accurate knowledge of the normal occurrences constitutes the first prerequisite for a proper understanding of pathological phenomena. With reference to the determination of the cause of the hyperplastic changes in the uterine mucosa, the physiology of the cyclic changes which occur in this structure may reasonably be regarded as providing the basis for the elucidation of the problem under consideration. In this connection it should be remembered that the doctrine of the "primacy of the ovum" in the causation of the cyclic

changes of the uterine mucosa, as well as in the regulation of menstrual periodicity has held sway for a long period of time. In a paper read abroad before a gynecological society in 1923, the writer pointed out that the bulk of evidence obtained both by experimental study and clinical observation strongly suggests that the regulation of ovarian periodicity and of menstrual rhythm is controlled by the anterior lobe of the pituitary and a correlated hypothalamic center. Without going into the details, it will suffice to indicate here the principal points. A subtle reciprocal relationship between the anterior pituitary and the ovarian follicles can be established by showing that the follicular fluid acts as a stimulus on the pituitary, which in turn initiates and promotes the ripening of follicles. In the light of these views, the cyclic endocrine activity of the two organs may be brought into consonance, and an acceptable explanation may be offered for the occurrence of rhythmical changes in the uterine mucosa. Zondek, in a recent paper, fully corroborates this conception.

With this phase of our knowledge of sex physiology established, the next obvious step was to learn whether it would be possible to produce in experimental animals an exaggeration of the proliferative phenomena which normally occur in the uterine mucosa during pro oestrus by the daily administration of pituitary substance over a prolonged period of time. Guinea pigs were chosen for these experiments since accurate data concerning the structure of the mucosa in the various stages of the cycle in this species have been established by the exhaustive studies of Stockard. Furthermore, the similarity in structure of the endometrium in that animal and in woman, made it appear possible that results obtained in the one might be transferred to the other without too great stretch of the imagination.

The growth promoting principle of the anterior lobe obtained from alkaline extracts of pituitary glands of beef prepared according to Evans' method has been used in the majority of the experiments, while a few animals were treated with acid extracts of the gland. In a third series of experiments bits of fresh an-

terior lobe were transplanted into the musculature of the thigh.¹ The extracts were injected intraperitoneally for 12 successive days, 1 cubic centimeter being the standard dose, while two transplantations were made during the course of 19 days. The animals were sacrificed on the thirteenth day in the former group and on the twentieth day in the latter.

Upon gross examination, the most noticeable feature in the uterus consisted in a considerable increase in circumference attended with a purple bluish discoloration. Another change consisted in the readiness of the uterus to contract, as manifested by the occurrence of peristaltic contractions which persisted after the animals had been killed. Of first importance among the data obtained on microscopic study of the thickened uterine mucosa is the fact that a striking increase of the connective tissue has taken place, its elements appearing definitely enlarged and at the same time more abundant. While this phenomenon is obvious in the entire mucosa, the increase of the interstitial tissue is most pronounced in its basal layer, which is considerably augmented in height and also in density. In the upper two thirds of the mucosa the glands are conspicuous by their great number. Their active proliferation is readily recognizable, as they have become greatly lengthened, more tortuous and occasionally branching. Cystic dilatation of the glands may be distinguished here and there in the middle layer of the mucosa. This occurred in quite a number of instances in the first group, but was most marked in animals which were treated by the method of transplantation. The histological findings may be best demonstrated by photomicrographs when it will be seen that Figure 3 bears a close resemblance to the "Swiss cheese pattern" of hyperplastic endometrium, as depicted by Novak.

The epithelium of the glands is of the high columnar type with no indication of secretion whatsoever. When the glands have become dilated the epithelium may be seen flattened. Extensive dilatation and engorgement of capillaries and also of vessels of a larger caliber are seen both in the uterine wall and in the

¹ Twenty-four animals were treated with the alkaline extract and with the acid extract while transplantations were made in 15 additional animals.



Fig 1 Photomicrograph showing conditions of uterine mucosa of guinea pig which had been injected for 12 days with alkaline extract of beef's anterior lobe. Note increase in connective tissue, lengthening of glands. U, uterine cavity. $\times 40$

mucosa. Discrete patches of extravasated blood may occur in the uppermost layer of the latter, independent of, or associated with, small areas of disintegration. Lymphocytic infiltration of the superficial zone of the uterine mucosa along with intense hyperaemia was a noticeable feature in a few specimens obtained from animals which had been injected with alkaline extracts immediately following abortion, and for 12 more days in succession. Formation of polypoid excrescences of the uterine mucosa may also occur under these conditions, as seen in Figure 2. Figure 4 exemplifies the condition of the uterine mucosa of a normal guinea pig (control).

The peculiar response of the ovaries to the administration of anterior pituitary is shown by reference to photomicrograph Figure 5. In general, it may be said that in marked contrast to the findings in the mouse, there is very slight, if any, enlargement of the ovary. In addition, while the condition of the ovary of the mouse is characterized by a marked hyperaemia and the occurrence of blood-spots ("blutpunkte"), in our series of experiments only a moderate congestion of the ovarian tissue may be seen upon histological examination. Moreover, there is no overproduction of lutein tissue, indeed, in the implanted animals luteinization is rather insignificant



Fig 2 Photomicrograph of uterine mucosa of another specimen after similar treatment. Note formation of polypus to which arrow points also dark area of disintegration beneath the uterine epithelium with lymphocytic infiltration. $\times 33$

The essential point in the ovarian picture after prolonged treatment or massive dosage of pituitary is seen in the occurrence of many cystic follicles with the granulosa persisting. This overproduction of atretic follicles strikingly resembles the phenomena found in "small cystic follicle atresia of the ovary," which occurs under certain gynecological conditions in women. Similar formations are known to obtain in the ovary during pregnancy, as well as in the ovary of the newborn. Smith and Engle in 1927 first described the formation of small follicular cysts in the



Fig 3 Photomicrograph of uterine mucosa obtained from guinea pig which had been transplanted twice with anterior lobe, showing "Swiss cheese pattern." $\times 33$

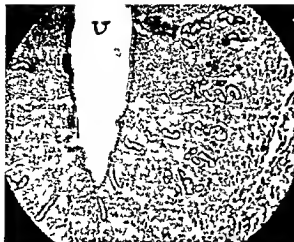


Fig 4 Photomicrograph of uterine mucosa of untreated guinea pig (control) $\times 45$

ovary of the rat after the repeated implantation of the anterior pituitary

The presentation of the pathological physiology of the uterine mucosa attendant upon the parenteral administration of anterior lobe of pituitary would be incomplete without considering the ovarian factor which affects the complex mechanism determining the uterine phenomena. In other words, in view of the protective influence of ovarian elements, follicle and corpus luteum, known to be far reaching on the function and cyclic changes peculiar to the uterine mucosa, it was deemed necessary to study the effect of the administration of anterior pituitary to spayed animals. It is particularly with this aspect of the question in mind that a few experiments have been conducted on guinea pigs which had been ovariectomized, and after a lapse of 2 weeks were subjected to the repeated injection of alkaline extracts or to transplantation of anterior pituitary. It seems permissible to conclude that whatever changes can be demonstrated upon microscopic study of such uteri must be attributed to the action of the anterior lobe of the pituitary gland and to it alone.

As an invariable feature, marked congestion of the uterus could be ascertained grossly, but distention and the tendency to contract were absent. Turning to the conditions found on microscopic study, the principle point which concerns us here is the slight thickness of the

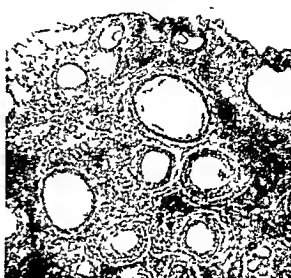


Fig 5 Photomicrograph of ovary obtained from guinea pig which had been transplanted twice with beef's anterior lobe. Note numerous atretic follicles $\times 45$

mucosa as compared with the specimens described above, there being no increase on the part of either the epithelium or interstitial tissue elements. There occurs, however, a definite, if slight thickening of the connective tissue in the basal layer of the mucosa which surrounds and supports the fundi of the glands. The epithelium of the fundi of the glands stains deeply, while in the upper part of the glands it displays less affinity to staining. To a slight extent dilatation of glands may be encountered in the superficial layer of the mucosa. Appreciable engorgement of the vessels obtains only in the muscle layer and also in the lowest part of the mucosa. Thus, it is apparent that following bilateral ovariectomy the reaction of the uterine mucosa to anterior pituitary is limited to the basals, and does not involve the entire thickness of the structure, as in the experiments mentioned.

SUMMARY AND CONCLUSIONS

The etiology of hyperplasia of the endometrium presents a problem which is still in adequately understood. Several writers have recently expressed the view that in all probability an unrecognized endocrine factor is concerned in the etiology of this condition.¹

¹In view of the present inadequate knowledge of the nature of hormones in the blood and in the urine great caution should be exercised in drawing conclusions from positive or negative findings in them.

Our investigations have shown that in guinea pigs treated parenterally with derivatives of the anterior pituitary, conditions may be produced in the uterine mucosa, as well as in the ovaries, which are practically identical with those observed in endometrial hyperplasia in women. This obtained so long as the ovaries were preserved, but when they had been removed, the process was limited to the basal portion of the endometrium. Our observations suggest the view that *hyperplasia may reasonably be regarded as the manifestation of an overactivity of the anterior pituitary lobe*. This conclusion, that an outside factor represents the primary cause of the disease is corroborated by the clinical experience that the condition commonly recurs after repeated curettage. If we accept this new conception concerning the etiology of hyperplasia of the endometrium, the application of X-rays to the pituitary with the view of suppressing its excessive activity enters upon a new phase. This method was introduced into the gynecological armamentarium for the relief of various conditions by the writer in 1922, and is now widely used not only on the continent but also in this country, mainly in the Mayo Clinic.

These studies have an obvious bearing upon the question as to whether the anterior lobe of the pituitary registers its effect on the uterine mucosa directly or through the agency of the ovary. Before we proceed to the

answer of this question, it appears desirable to emphasize that at the present time the view advanced by Corner and Allen is preponderant. They consider that the release of a certain supply of follicular hormone initiates the cyclic uterine phenomena, which subsequently culminate in the formation of pre-gestational changes as a response to additional hormonal influences derived from the corpus luteum. Furthermore, they hold that the integrity of the entire endometrium depends upon the influence of the ovarian hormone. Our observations, however, indicate that the internal secretion of the ovary is essential for the changes occurring in the upper part of the uterine mucosa—the “functionalis,” while the basal layer is under the control of the anterior pituitary lobe, as judged by the response of this structure to repeated pituitary administration in ovariectomized animals.

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FOLLICULAR DESTRUCTION IN THE NORMAL THYROID OF THE DOG

WITH A CONSIDERATION OF THE RELATION BETWEEN FOLLICLES AND INTERFOLLICULAR CELLS

CUSTAV ZICHSEL, M.D., CHICAGO

Associate in Anatomy and Surgery, University of Illinois College of Medicine

IN the course of experimental work to determine whether or not regeneration of the thyroid occurs after ablation and what effect, if any, the capsule has in this process, the writer discovered that even in the normal thyroid of the dog there is evidence of destruction and new formation of follicles. In perusing the literature he found that no reference is made to such events in the normal life of the thyroid. Consequently it was deemed advisable to focus attention on these processes before proceeding with the major problem in mind.

The question arose whether there is a uniform type of follicle unchanging in shape and size or whether there are types differing in these characteristics. A second question pertained to the importance of the cell groups scattered between the follicles which are known in the literature as the interfollicular or interstitial cells. Hitherto most investigators in their studies of the thyroid gland have only emphasized the follicles and the enclosed colloid and have hardly given any attention to these cells. Indeed histological textbooks make little note of such features. The observations presented here show that the interstitial cells certainly are as important as the follicular cells, a fact which becomes evident especially when the relations existing between the follicles and the interfollicular cell groups are taken into consideration.

MATERIAL AND METHODS

The thyroids of 14 dogs were examined in the course of this study. The material was obtained by biopsy. Both glands were exposed and the ventral half of each was removed under proper precautions to prevent any damage to tissue. The dorsal half was left in its normal place for other studies. The specimens were immediately put into formalin or Mueller's solution and were afterward embedded in paraffin and cut into serial sec-

tions 10 micra in thickness. The majority were stained with hematoxylin and eosin, and a few by van Gieson's method. In every case the tissue of both glands was studied, and care was taken to eliminate glands which were suspected of any pathologic changes.

OBSERVATIONS

1. *Concerning the growth of follicles.* In many cases the follicles may show little variation in size, but upon comparison with other areas the differences in size become more evident (Fig. 1). Very small follicles—probably of young age—are usually arranged in a group. These really are small follicles and cannot be interpreted as caps of larger follicles sectioned tangentially, because they lie close to each other and the follicular wall is represented by a single layer of cells. Were they caps of larger follicles cut at a tangent, it is obvious that the wall would appear to be composed of several layers of cells. The correctness of the above interpretation was further established by tracing such follicles through the series, when it is found that their lumen does not increase in size in the following section. In section the simplest follicles seem to consist of three or four cells only. The central poles of the cells of such a small group show the same staining as the colloid in young follicles and there can be no doubt that the colloid is a product of these cells. In another stage, perhaps slightly more advanced, a small droplet of colloid is already present in the center of the group and yet connected with the surrounding cells. One single section often reveals all the different stages between large areas of middle sized follicles. During their growth the follicles expand by a numerical increase of cells proportionate to the diameter. It need not be decided here whether the number of follicular cells grows by cleavage or by the invasion or incorporation of interfollicular cells into the follicular wall and there become

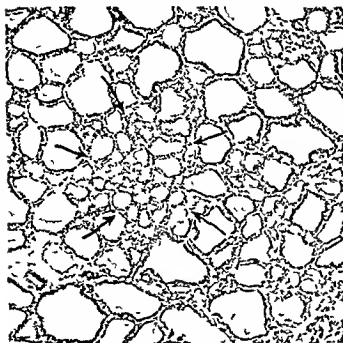


Fig 1 Photomicrograph of a section of thyroid of dog $\times 90$

ing follicular cells, as suggested by Huerthle.¹ It is improbable that a follicle grows merely by distension caused by the accumulation of colloid, for no large follicles exist which are lined by a small number of cells

¹Huerthle E. Arch f Physiol 1894 lvi 35

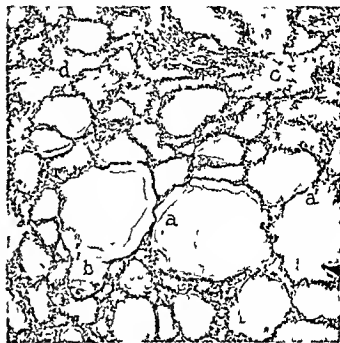


Fig 2 Photomicrograph of a section of thyroid of dog follicles indicated by *a* and *a'* showing beginning fusion with adjoining follicles, at *b* two follicles have become broadly confluent at *c* numbers of compressed follicles have coalesced with one another to form irregular colloid spaces, *d*, colloid space $\times 110$

2 Two types of follicle destruction The epithelium of the fully developed follicles is usually cuboidal but may assume squamous



Fig 3 Photomicrograph of a section of thyroid of dog. At *a* large colloid space formed by the breaking up of many follicles and containing the cellular debris resulting from such disintegration. At *b* an area of collapsed follicles $\times 110$



Fig 4 Photomicrograph of a section of thyroid of dog. At *a* and *b* irregular colloid spaces formed by the fusion of regressive follicles, note the shreds of epithelium and scattered cells in their cavities, also the compressed or collapsed follicles radiating from these irregular cavities $\times 110$



Fig 5 Photomicrograph of a section of thyroid of dog. The territory outlined (by dotted line) and indicated by A reveals early stages in the collapse of follicles $\times 110$

character at points at which two follicles are in contact with one another. Finally their walls break through at such points, and a larger space results which is filled with colloid and lined with the rests of the epithelium,

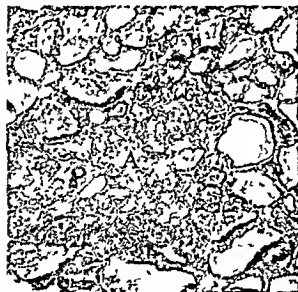


Fig 7 Photomicrograph of a section of thyroid of dog. At A an early stage in the disintegration of a large group of follicles with the scattering of their cells engulfed in colloid. Near the lower left half margin of picture the walls or outlines of the original follicles are still barely visible $\times 110$



Fig 6 Photomicrograph of a section of thyroid of dog. A represents a large colloidal cavity formed by the flowing together of follicles. At a a small follicle just merging with the larger cavity. At b an epithelial wall just before breaking away during the process of follicular fusion. At c vestiges of such epithelial walls. At d compressed or collapsed follicles $\times 110$

(Fig 2, a and a') Sometimes more follicles fuse and create still larger colloidal spaces which in extreme cases appear like cysts (Figs 2, c and d, 3, a, 4, a and b). They differ from cysts, however, by being lined not by a continuous epithelial layer but by fragments of such which often project into the colloid of these spaces (Fig 4, a). There may be a relation between such a normal event and the formation of a cyst which could develop either by the growth of a single follicle or the fusion of many follicles (Fig 6, A). In some localities the fusion occurs so rapidly that parts of the follicular wall are engulfed by colloid (Fig 6, A and d), the cells seeming to dissolve entirely in it and their protoplasm becoming indistinguishable as such. The pyknotic nuclei which become evident during the regressive changes finally disappear also. As for the colloid it is difficult to say whether it is resorbed from these large cavities.

Another type of follicular destruction occurs without involving the degeneration and death of the individual cells and represents merely a cellular rearrangement with reduction in the amount of colloid. Follicles undergoing

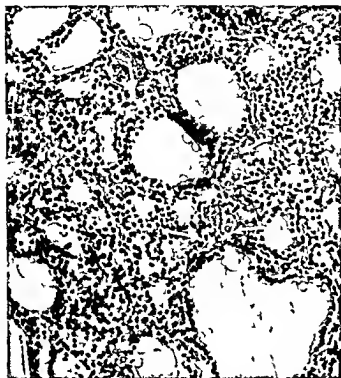


Fig 8 Photomicrograph of a section of thyroid of dog. New formation of follicles may be observed in a cell group originating from destroyed follicles. Arrows indicate large cells described in text. $\times 200$

this method of regression assume a collapsed and compressed appearance so that their epithelium extends in double parallel rows (Figs 2 to the left of *c*, 3, *b*, 4, to the left of *a*, 5, *A*, 6, *e*). In time these rows break up, resulting in groups of cells without any definite organization (Fig 7, *A*). The fact that such retrogression of follicles is seen among normal follicles in the depth of the gland no less than at the surface is sufficient evidence that it is not an artefact caused by handling. With the breaking up of the follicles, the colloid becomes scattered in the form of small irregular masses and particles between the cells and ultimately vanishes completely.

I like the first type of follicular destruction described, this type likewise may involve a larger number of follicles associated in a group.

3. *The interfollicular cells* Two kinds of interfollicular cells can be distinguished. One variety of cell group may probably be considered as having remained embryonic in nature and as awaiting the development in follicles, and the other as arising by the breaking up of follicles. Cell groups of the former

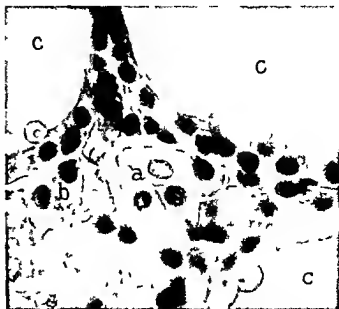


Fig 9 Photomicrograph of a section of thyroid of dog. *a* represents a group of large cells, with homogenous cytoplasm containing nuclei with a very distinct chromatin network. At *b* two interfollicular cells almost identical with cells lining follicles. *c* indicates "normal" follicles. $\times 500$

variety show considerable similarity with embryonic thyroid tissue and here and there reveal small follicles lined by few cells. They are far more frequent in the glands of younger animals than in those of old ones in which corresponding places are composed for the most part of small follicles (Fig 1). In many



Fig 10 Photomicrograph of a section of thyroid of dog. *a* and *b* indicate groups of large interfollicular cells, probably a short period before fusion of the central poles. At *c* groups of cells originated from destroyed follicles. *d* represents small young follicle and *e* large and old follicle. $\times 500$

cases it is difficult to differentiate between aggregates of embryonic cells and such arising from regressive follicles. All stages between follicles normal in appearance and cell groups resulting from their destruction exist and can be observed. In other words, no sharp division can be drawn between the several steps, so gradual is the change from the former into the latter. It is clear that the morphology of the interfollicular cell groups can be understood only by the study of their development.

In all groups of interfollicular cells originating from follicular destruction two different types of cells have been found. First there are cells—the prevailing type—which are similar to or identical with cells that line the follicles. They are cuboidal or cylindrical in shape and contain a nucleus which is generally elliptical, but may occasionally be round. It takes a dense stain and shows no finer structure. The other type of cell is larger, is almost spherical and possesses a homogenous protoplasm and a large, lightly staining nucleus with a distinct net of chromatin. The cytoplasm colors brightly with eosin, and since such a cell occurs in groups of 2 or 6, these groups appear as little pink spots between the surrounding cells and represent the origin of new follicles (Figs 8 to 10). Superficially at least their protoplasm seems to be identical with colloid. In studies on the thyroid, other authors have hardly recognized these two types of interfollicular cells, hence they are deserving of further investigation.

CONCLUSIONS AND SUMMARY

The present observations show that the follicle is not the only structure of morphological importance in the thyroid gland. The study of the interfollicular cells reveals that between these two extremes of morphological composition there are many stages of transition. The follicle is not a permanent structure but merely a phase in structural metamorphosis which alternates between two

extremes, the follicle on one end and the interfollicular cell group on the other.

Follicles break up and after the lowest point of disorganization is reached the reorganization of new follicles commences from cells which are spherical, are larger than follicular cells, and possess a cytoplasm that is homogenous and stainable like the colloid itself, and a nucleus that is large and chromatic. On the other hand the cell of a large or "old" follicle is cuboidal, the cytoplasm is poorly stainable and the nucleus more or less pyknotic and elliptical. For the most part the process of destruction strikes the follicle and not the cell. The latter merely accepts a different arrangement. However, where the formation of large colloid spaces occurs by the coalescence and confluence of follicles, some cells become engulfed, undergo dissolution and disappear in the colloid.

From these observations there is evidence to assume that during the life cycle of the thyroid a cell may appear and reappear in successive follicles. For new follicles are formed from the cellular components of disintegrated follicles. It may be supposed further that a cell is able to produce colloid but for a limited period, and then requires a period of inactivity to prepare itself for a renewal of secretory function in company with like fellows—the interfollicular cells—which together initiate a new follicle.

The regression of follicles seems to facilitate the resorption of colloid. The disintegration of their walls permits the colloid easily to escape and to appear among the surrounding cells. Here too such material finally disappears.

If these interpretations of the observed conditions are correct, then a new basis is given for the understanding of the pathology of the thyroid. It is conceivable how differences in such pathology may result from the unbalance or overemphasis of any one phase in the follicular life cycle of the thyroid.

CLINICAL SURGERY

FROM THE RUDOLFSPI TAL, VIENNA

VAGINAL EXTIRPATION OF THE UTERUS AND ADNEXA ON BOTH SIDES

PROFESSOR DR PAUL WERNER, VIENNA, AUSTRIA

IN the September, 1929, issue of SURGERY, GYNECOLOGY AND OBSTETRICS, I described a simple method of extirpating the uterus by the vaginal route. If it is necessary to remove the adnexa as well as the uterus, extirpation may be accomplished after the hysterectomy by pulling down the organs on one or both sides and excising them. This operation is not exactly easy, indeed, it may be difficult even to the experienced operator if adhesions are present, but such difficulties may be avoided or considerably lessened, if the uterine extirpation is modified as I shall describe. The idea of the modification is to split the uterus *in situ* and to extirpate each half with its adnexa.

This operation is indicated when inflammatory adnexal tumors with perimetrial adhesions are present and conservative treatment has failed, thus making total extirpation ultimately necessary. The method is useful also in vaginal hysterectomy for bleeding or for fibroids, especially when technical difficulties present themselves, such as obscure anatomical relations, reflected peritoneal folds, or similar difficulties, which make the approach difficult. The operator will be surprised how much easier hysterectomy may be performed if the uterus is split. A further great advantage of the operation is that the difficult seeking and opening of the anterior fold of Douglas are avoided, also that it is not especially essential that the posterior fold of Douglas be sought. The posterior fold of Douglas is generally easy to find, but at times it may be rather difficult to locate and open. As will be explained, opening of the peritoneum occurs spontaneously. The operator, who knows how often in old chronic inflammation of the pelvis, the excavatio vesico uterina becomes obliterated or drawn sideways, will appreciate these advantages. A further advantage of the splitting method is that extensively adherent adnexa may easily be drawn down into the field of operation by pulling on the corresponding part of the

uterus. The adnexa may then be loosened from their adhesions and extirpated.

In vaginal operations it is generally necessary that the organ to be removed be entirely mobile. Even staunch advocates of the vaginal route would hardly use this route in removing an ovarian cyst, for example, if the ovary were adherent to the surrounding structures. The operation which I shall describe makes this important requirement unnecessary, for in cases of inflammatory adnexal tumors it is possible to pull down the tumors with sufficient force that the adhesions to the corresponding part of the uterus may be loosened under the guidance of the eye, not only with the fingers but also frequently with instruments such as scissors and knife. It may well be noted here that my operation is especially applicable in cases in which the uterus is fixed. More or less marked changes in the adnexa are to be found in such cases. These changes may be overlooked on clinical examination because of the position of the adnexa above and to the side of the corpus uteri which lies deeply in the pouch of Douglas. A further advantage of the vaginal route is that the field of operation is close at hand thus eliminating the necessity of deep narcosis during the freeing of adhesions and at the same time overcoming some of the technical difficulties of the abdominal route.

Convalescence is generally very rapid and smooth. The danger of peritonitis, which always threatens after a laparotomy, especially when large pus pockets have been opened, is altogether absent or is very slight. The infectious material flows out through the vagina and does not spread into the abdominal cavity or even touch the higher parts of the peritoneum. Now and then, suppuration of the abdominal layers is likely to occur after the abdominal removal of inflammatory tumors, but if the vaginal route is used, one need not be concerned with this complication.



Fig 1 1 Exposed cervix wall 2, cutting surface

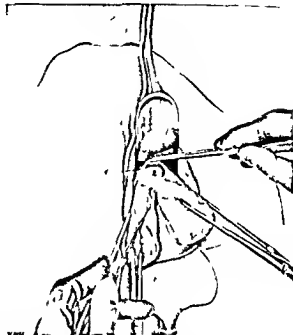


Fig 2 1 Phica 2, anterior surface of the body 3 split cervix

Finally, we must not forget that here as in all vaginal operations convalescence is short and relatively painless and the patient is able to return to work in a relatively short time

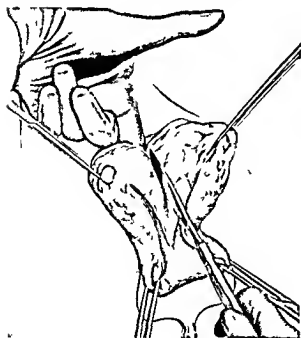


Fig 3 1 Uterine cavity, 2 posterior wall of the uterus

Indications I have already mentioned that this procedure is indicated in cases with inflammatory genital affections of all sorts, especially when the uterus is fixed in retroflexion. It is indicated also in the presence of old parametritical exudate and of scars which no longer respond to conservative therapy. In such cases resorption of the infiltrated material occurs only after removal of the uterus. If the tumor is large enough to reach to the navel, it is better not to use the vaginal route as we do not know whether the adhesions high up in the abdominal cavity can be loosened by a pull, even a strong one, from the direction of the vagina. These cases are very rare, however.

Anesthesia Only inhalation narcosis or spinal anesthesia is to be considered. Local, sacral, and parasacral anesthesia, is eliminated because complete anesthesia is not to be expected from it. If adhesions reach high up in the pelvic peritoneum, a general anesthetic is necessary. Personally, I prefer pure ether narcosis, which has always proved sufficient and, because the operation consumes little time, carries very little danger with it.

Pre-operative treatment Special pre-operative treatment is not necessary. The bowels must be emptied on the day previous to the operation. An enema on the day of the operation should be avoided because retained water might pass during

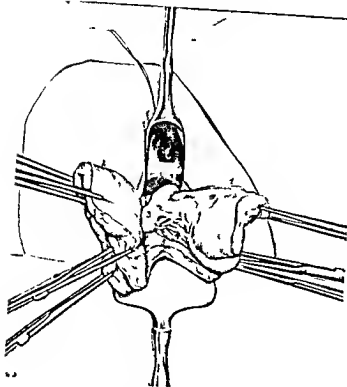


Fig 4 1, Left half of the uterus, 2, right half of the uterus, 3, left tube, 4, adhesions, 5, peritoneal covering of Douglas's pouch

the operation and endanger asepsis Half an hour before the operation the patient is given 0.02 pantopon and 0.003 atropin subcutaneously

TECHNIQUE

After the patient is placed on the operating table the vagina is exposed with retractors and the cervix is grasped with tenacula and pulled down It is advantageous to use two tenacula on the anterior lip and one on the posterior lip In this way a greater pull can be exerted without the danger of the tenacula tearing out Immediately above the cervix a transverse incision is made through the anterior vault of the vagina and the bladder is loosened from the anterior wall of the cervix exactly as described in my previous article on the extirpation of the uterus In simple extirpation of the uterus, the operator at this point tries to open the peritoneum of the vesico uterine fold, in my operation, however, that is quite superfluous A retractor is introduced between the bladder and the anterior wall of the cervix and the latter is split with scissors as far as it is free of the bladder (Fig 1) Now both tenacula which were inserted in the anterior lip of the cervix are inserted immediately below the upper end of the cervical cut With the finger it is determined whether the bladder is entirely separated and if separated the incision is then carried up-

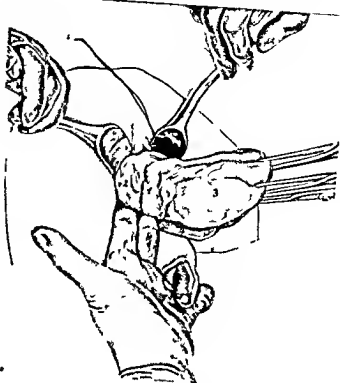


Fig 5 1, Tube, 2, ovary, 3, left half of the body, 4, left half of the cervix

ward as nearly as possible in the middle line Thus the plica vesico uterina is opened (Fig 2) The anterior retractor is now introduced through the



Fig 6 1, Uterus and 2, tumor



Fig. 7 1 Infundibulopelvic ligament 2 round ligament 3 uterosacral ligament 4 posterior wall of the vagina 5 gauze pack

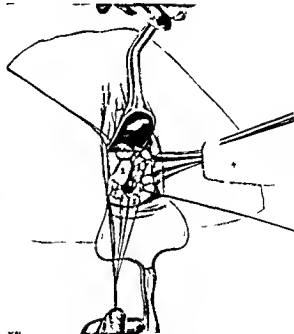


Fig. 8 1 Stumps 2 posterior vaginal wall and peritoneum 3 bowels 4 gauze

newly made hole into the peritoneal cavity and by gradually climbing higher with the tenacula the splitting in the median line is continued. The adhesions on the uterus may first be loosened with the finger. When the incision has reached the fundus it is generally possible to pull it before the vulva and the splitting can be continued through the posterior wall down to the posterior lip of the cervix either by scissors or with a knife, as in Figure 3. Figure 4 shows the uterus split in two parts and pulled apart. When the uterus is thus pulled apart the adnexal tumors appear in the depth. In our picture the observer is looking at the field from the right side. If the splitting is really done in the median line there is no bleeding worth mentioning because the blood vessels enter the uterus from the side and go toward the median line so that the field of operation is relatively anæmic and the larger vessels are not cut.

The next step is the freeing of the adnexal tumors and the extirpation of them together with the part of the uterus to which they are attached. I make it a practice to loosen and remove first the tumor of the side which seems less difficult to handle. The advantage of this is that then there is more room in which to work in loosening and extirpating the more adherent tumor. In the case described the left side seemed to present less difficulty. Therefore, the right half of the

uterus was put back into the peritoneal cavity and the left half was pulled down. This manipulation caused the adnexal tumor to descend markedly toward the vulva and to come well into sight (Fig. 5). In Figure 6 the tumor is shown freed of its adhesions and connected with the pelvis only by the ligamentum infundibulopelvicum. The freeing was done with the index and middle fingers of the left hand that is, the hand corresponding to the left side of the pelvis of the patient. As soon as the tumor is completely freed that is when the tumor is pedunculated, I begin to separate the tissue from the ligamentum infundibulopelvicum after having attached clamps, and after the ligamentum infundibulopelvicum the ligamentum rotundum and then the ligamentum latum and finally the ligamentum sacro-uterinum and that part of it belonging to the posterior wall of the vagina. Figure 7 shows this part of the operation. There now remains only a part of the ligamentum sacro-uterinum and the posterior wall of the vagina to be extirpated. The parts of the ligamentum latum which lie higher up have already been clamped and separated. Finally, when the part of the uterus with its adnexa has been extirpated ligatures are placed and the clamps removed (I use only catgut).

We now are ready to take care of the opposite side and we carry out the same procedure here

As already mentioned it is generally easier to work as there is more space for the operating hand

When both sides have been freed of the tumor the peritoneum of the bladder is fixed to the anterior wall of the vagina, the Douglas peritoneum to the posterior wall, and the stumps of the ligamentum latum to the lateral edges of the incision. The ligamenta infundibulopelvica frequently inflamed and infiltrated are generally too short to be brought to the edge of the vagina. They are allowed to slip back into the abdominal cavity without further care. Figure 8 shows the peritoneum and the stumps fixed as far as possible to the cut edge of the vagina. In the cavity intestinal loops are visible. Since it is generally impossible to check bleeding completely when inflammatory tumors are freed of their adhesions and removed, the peritoneal cavity must not be closed but should be kept open to allow drainage. For this purpose, a strip of iodoform gauze is placed loosely in the peritoneal cavity and led out through the vagina.

The fear that prolapse of the intestines may occur is unfounded as has been proved through experiences with many hundred cases

AFTER-TREATMENT

The after-treatment is very simple. Beginning on the fourth day after operation, a piece of the strip of iodoform gauze is pulled out each day and cut off so that finally on the seventh or eighth day the whole strip has been removed. Two days after the complete removal of the gauze, vaginal douches, generally of a solution of potassium permanganate, should be given. As early as the third or fourth day after operation the patient may get up and as a rule on the eighth to tenth day she is able to leave the hospital. It is desirable that before she leaves the hospital the patient be examined once more on the table. The vagina is exposed with retractors and the granulating wound is inspected. If necessary, tincture of iodine is applied. Vaginal douches must be continued until the discharge, which exists after every such operation, disappears.

FROM THE SURGICAL CLINIC, UNIVERSITY OF HEIDELBERG

TECHNIQUE OF THYROIDECTOMY

MORRIS L. PARKER, M.D., CHICAGO

Formerly Exchange Assistant at The Surgical Clinic, University of Heidelberg. Gehemrat Enderlen, Director

ABOUT 20 per cent of the entire population of the Middle Rhine District is affected with goiter. These are colloid in type and vary in size from those which are barely noticeable to those of extreme dimensions, producing symptoms of compression. The incidence of toxicity is small, about 10 per cent in the cases operated upon. Primary hyperthyroidism is rare.

In Germany, all working people are members of a *Krankenkasse*.¹ During the period when goiters were recognized by these institutions as a condition warranting full compensation, the number of thyroidectomies in this clinic was about 600 annually. Since this compensation has been decreased, the number has diminished to approximately 250.

INDICATIONS

Aside from primary hyperthyroidism, or toxic adenoma, pressure symptoms are the chief reason for the operation. As the figures mentioned indicate, the operation is seldom performed for cosmetic effects. The goiters seen here are usually large, generally substernal, producing displacement of the trachea, with consequent cough, dyspnea, and occasionally difficulty in swallowing. Stimulation of the sympathetic, as characterized by Horner's syndrome, and irritation of the recurrent laryngeal nerve, characterized by hoarseness, are frequently present on admission. The patients postpone operation as long as possible. Secondary myocardial changes, particularly hypertrophy and occasional cardiac irregularity, are therefore frequently noted.

PRE-OPERATIVE TREATMENT

The pre-operative treatment is not of as much importance as in the toxic cases. A complete general examination, to determine the condition of the patient as to being an operable risk as well as the presence of coincidental diseases, is essential. Basal metabolic rate is determined only in cases of suspected toxicity. All patients are examined with the fluoroscope to determine whether the trachea is displaced or compressed as well as

to ascertain whether the gland is substernal and, if so, whether it is movable. The condition of the heart and lungs is observed at the same time. Laryngoscopic examination is performed almost routinely and particularly in individuals using the voice a great deal, as actors, singers, and priests, to detect any involvement of the laryngeal nerve which may be present without symptoms and can not be determined otherwise. In cases where indicated a few days' rest is permitted and cardiac therapy instituted. Patients who have toxic symptoms are treated with Lugol's solution, which is given in sufficient quantity and over a period until the condition warrants operation.

ANESTHESIA

All operations, except in the occasional highly toxic case, are performed under local anesthesia. The technique of the method is simple, it absolutely excludes pain, renders the field relatively bloodless, avoids additional damage to the already overburdened heart, lungs (in the presence of emphysema), and compressed trachea. What is more important, it enables the operator to converse with the patient and thus minimize injury to the recurrent laryngeal nerve. Using 1 per cent novocain with adrenalin, 15 to 20 cubic centimeters is injected subcutaneously at the level of the incision from one sternomastoid to the other. The middle of the sternomastoid at its posterior border is located, and the injecting needle is inserted at this point. Ten cubic centimeters is injected subfascially on both sides along the entire muscle to block the anterior cervical nerves. Now the superior pole is located and another 10 cubic centimeters injected. This suffices in practically all cases (Fig. 1). The presence of adrenalin in the mixture prolongs the duration of the anesthesia for 2 to 3 hours. In large goiters and those which extend a considerable distance behind the sternum, paravertebral injection may be added over the second, third, and fourth transverse processes of the cervical vertebrae. Frequent aspirations of the syringe must be made during the process of injection to detect possible entrance into a blood vessel. The paravertebral procedure is associated with some degree of danger and is not generally used. With a previously adminis-

¹ *Krankenkasse* is an organization of social insurance providing compensation in case of illness or accident, civil or industrial. All people with an income of 6,000 marks per year or less (about \$1,500.00) are compelled to have this form of insurance. Thus a large majority of the working people and their families are protected and cared for by these institutions.

tered injection of morphin and atropin the patients go through the operation without discomfort. In very toxic cases and in children, general anaesthesia may be added if the patient is very excitable or the condition requires it, but it is used in less than 1 per cent of the operations.

TECHNIQUE

As stated above, the goiters operated upon here are usually large. Pathologically, they can be grouped as follows: (a) large nodular or adenomatous goiter, (b) diffuse parenchymatous (very vascular and pulsating), (c) diffuse colloid. As a fourth group may be added the primary toxic type. In cases of large goiters, very careful and gentle manipulation as well as anatomical progression are essential to avoid danger to the adjacent structures. The position of the patient should be such as to permit extension of the neck without at the same time producing discomfort or interference with respiration. The patient lies on a flat table with a pad under the shoulders, the back of the head resting on the table. The head of the table need not be elevated. The patient is draped and the face is covered with sterile linen. An ether mask is put over the mouth and nose to make breathing easier. The operator is at the right of the patient, the first assistant at the left, and the second assistant at the head end of the table, so that everyone has ample working space.

The skin incision, which includes the platysma, is of the usual Kocher type, transverse or curved, depending on the size of the goiter, and placed so as to allow sufficient exposure and at the same time give a satisfactory cosmetic result. The skin is deflected upward as far as the thyroid cartilage and then held in place by towel clips. The large veins lying on the surface of the fascia are doubly ligated and divided, to avoid possible air embolism later. The prethyroid strap muscles (sternohyoid and sternothyroid) are then divided transversely without clamps and without dissecting off the fascia from underneath one sternomastoid to the other (Fig. 2). All bleeding points are ligated. The gland is thus well exposed and can be delivered with comparative ease (Fig. 3).

The essential principles in the technique are as follows: careful isolation of all structures, thorough hæmostasis, and elimination of as many clamps as possible. The cut ends of the strap muscles at the right upper pole are retracted. By gentle manipulation with the finger, pulling down on the thyroid tissue in that region and loosening the connective tissue web with a Kocher dissector, the vessels of the superior pole are exposed. Each vessel is individually isolated, doubly ligated, and

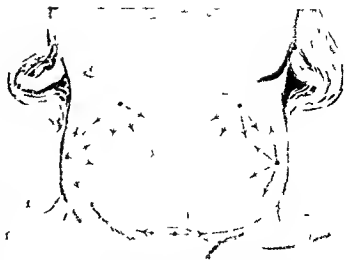


Fig. 1 Scheme for local anæsthesia. Injection along line of incision at middle of sternomastoids and over superior poles.

divided. The superior thyroid artery is ligated with three ligatures, one being left on the proximal and the others on the distal end (Fig. 4). A clamp is now applied to the thyroid at the upper pole. The mobilization of the right lobe is begun. This is accomplished by retraction of the sternomastoid, ligation of the lateral and inferior thyroid veins, and separation of the fine connective tissue which is adherent all around the lobe. This permits complete mobilization and dislocation of the gland medially. At this time the inferior thyroid artery comes clearly into view. The inferior thyroid artery comes from the thyrocervical trunk lateral to the carotid, travels upward, and at the level of the transverse process of the sixth cervical vertebra appears from under the carotid and goes medially almost straight across to enter the gland. It is easily isolated at this point and is doubly ligated lateral to where it enters the gland and close to where it crosses the carotid. It is not divided, in order not to disturb its anatomical relationship to the laryngeal nerve. The recurrent laryngeal nerve, running generally beneath, occasionally above, and sometimes between the terminal branches of the artery, about 1 to 2 centimeters from the trachea at this point (Fig. 5), is seen at the same time (4). The lower pole is now mobilized and if substernal may be dislocated upward with impunity, as there is practically no danger of hæmorrhage, particularly if not too much tension is applied to tear the thyroid. If it is difficult to bring up the substernal portion, traction may be applied by means of tension sutures or clamps. Cutting of the sternum is too dangerous and is generally unnecessary. On the left side a similar procedure is carried out, and when it is completed

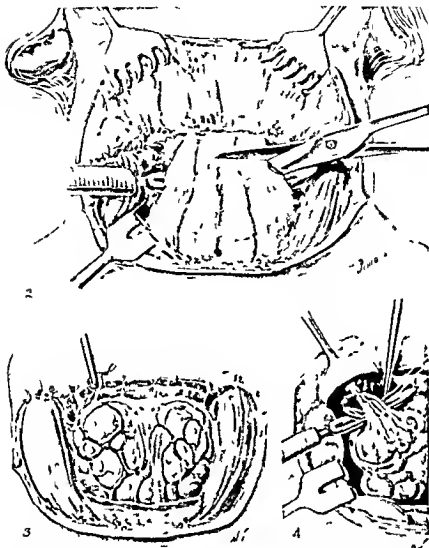


Fig 2 The strap muscles together with the overlying fascia are cut from one side to the other. The sternomastoids are retracted laterally.

Fig 3 Appearance of field after muscles have been cut and vessels ligated. The thyroid is exposed.

Fig 4 Ligation of superior pole. The vessels are usually isolated individually and doubly ligated.

the pyramidal lobe is dissected free. The isthmus is then divided by passing a Kocher dissector between it and the trachea, cutting over the dissector as a guide (Fig 6).

The thyroid is now separated by means of sharp dissection, so that only the fine web like connective tissue on the surface of the trachea is left. Both lobes of the gland are now entirely free, being attached for only a short distance along the trachea. The amount of glandular tissue desired, usually all except a thin layer on top of

the posterior capsule, is now cut off from each lobe. The amount of good thyroid tissue necessary for body function is about the size of a hazel nut on each side. All bleeding points are ligated and each lobe remnant is sutured separately, uniting the lower with the upper pole, and the raw edges are inverted (Fig 7). This method is considered more advantageous than the lateral suture of the thyroid stump because it restores the lobe to a practically normal shape and prevents the exudation of any secretion.

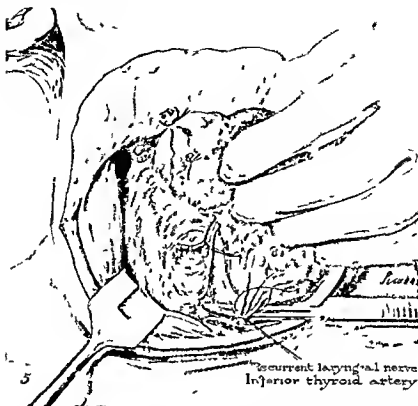


Fig 5 Thyroid is dislocated medially. The areolar tissue behind the capsule has been loosened exposing the inferior thyroid artery, which is doubly ligated but not cut. The recurrent laryngeal nerve is exposed at the same time.

In those cases in which the pathological process is limited to one side only, hemithyroidectomy is performed.

The patient is now asked to cough, the straining revealing any bleeding points, which are then properly controlled. The pillow is then removed from under the shoulders, permitting the neck to flex, and the strap muscles are sutured in proper alignment with interrupted sutures (Fig 8). The fascia left adherent to the muscles does not permit the cutting through of sutures. The skin is similarly closed, and a thin glass drain is left in place at the most dependent point. A firm bandage, including the head and making a figure of eight around the upper part of the chest, is applied to exert a little compression on the neck and at the same time provide stability, thus eliminating some pain produced in turning the head.

By this technique the great dangers of the operation are avoided. There is complete exposure and mobilization of the gland. As there is little bleeding there is practically no blood loss. Hemostasis is easily secured in the step like procedure, each vessel being doubly ligated as it is encountered before it is cut. The parathyroid glands, which are usually on the posterior capsule, are spared, and if they are in another position are

seen and avoided. Finally, the recurrent laryngeal nerve is actually seen and is not injured.

POSTOPERATIVE TREATMENT

On returning from the operating room, patients are placed in bed in a semisitting position. Fluids are given by mouth as soon as they can be swallowed without difficulty. A steam kettle is provided to relieve the tracheal irritation, and morphin is given in sufficient quantities to produce rest and relieve pain during the first day. In cases of toxic goiter Lugol's solution in appropriate dosage is added. Complications are treated as they arise, but they are relatively infrequent. The drain is removed in 24 hours, sutures on the fifth day, and patients are generally discharged on the eighth day.

COMPLICATIONS

Complications which may occur during and after thyroidectomy are as follows:

A *Postoperative hemorrhage*, more frequent after general anesthesia, is one of the most feared, and justly so, because, if extensive, it may prove rapidly fatal, either from compression of the trachea, loss of blood, or substernal hematoma with subsequent infection. It can best be avoided

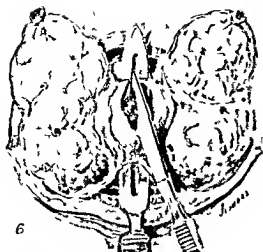


Fig 6 A Kocher dissector is passed over the trachea and the isthmus is cut through

by careful isolation and ligation of the particularly large vessels during the operation. However, faulty ligation is not always the cause (3). Changes in the vessel wall or retraction of muscle fibers included in the ligature, particularly at the upper pole, may allow the ligature to slip off. Moderate hemorrhage may make itself apparent on the dressings, coming through the drain. The danger sign, however, is progressive or suddenly developing dyspnea with cyanosis, choking spells with rapid weak pulse, indicating tracheal compression, which may quickly result in a fatal asphyxia. As soon as these symptoms appear the dressings must be loosened and the wound examined. If hemorrhage is suspected or ascertained, the incision should be reopened and the clot evacuated. The bleeding vessel, if possible, should be caught and ligated and the wound again closed in layers and drained. If the vessel cannot be secured, and the wound continues to ooze, it should be packed with gauze and left unsutured. It may be secondarily closed in 24 to 48 hours. If the local edema and infiltration of blood is extensive, tracheotomy may be indicated.

B Tetany occurs at times (in 2 per cent of cases here) after primary thyroidectomy, but is most common following operations for recurrent thyroid where the anatomy is distorted, even if only one side has been previously removed. In this district tetany frequently occurs even following operations other than thyroidectomy. In many cases the Chvostek sign is positive even before operation. The tetany may be mild, varying from mere discomfort, tingling, and muscular spasms, to the most severe paroxysms which may

terminate fatally. The presence of the Trousseau and Chvostek sign is diagnostic, and Erb's increased muscular irritability and the diminution in blood calcium are confirmatory. Tetany is a result of the removal of, or damage to, the parathyroid glands. That it does not result from insufficient blood supply to the parathyroids, subsequent to the ligation of the four thyroid arteries, has been demonstrated beyond question by the work of Enderlen and Hotz, Pettenkofer and others (1). The usual therapy consists in the administration of sedatives and calcium lactate or chloride (15 to 30 grams daily) by mouth, or 10 cubic centimeters of a 10 per cent solution intravenously. Afenil may be used for the same purpose. Dietary measures, such as the elimination of meats and the substitution of large quantities of milk, may be instituted. The feeding of thyroid and parathyroid extract alone is generally unsuccessful. Collip's extract (parathormone) is, however, valuable. Transplantation (autogenous) may be performed if the removal of parathyroid is detected and the structures recognized at the time of operation. Homeotransplants are of little avail. If the patient still possesses some parathyroid tissue the attacks may be prevented or controlled and the patient tided over the danger point, until compensatory hypertrophy occurs by other means.

C Tracheitis follows practically every thyroidectomy. It varies in degree with the amount of manipulation and tugging on the trachea. The severity of this condition is prevented and relieved by steam inhalations. Occasionally a bronchitis follows and the elevation of temperature, which generally occurs on the second and third days after operation, is said by some to be due to mild bronchopneumonia. Actual postoperative pneumonia after thyroidectomy, however, is rare, particularly following the use of local anesthesia and in the absence of recurrent laryngeal nerve injury.

D Embolism may be of two types—air embolism or pulmonary embolism.

Air embolism, resulting from the aspiration of air into the injured large neck veins, occurs, but fortunately not commonly, and never has happened at this clinic. The condition is real, and not a mere possibility, and may terminate fatally very quickly during the course of the operation if the quantity of air absorbed is sufficiently large. Aspiration of air is characterized by a hissing sound and requires immediate covering of the field with a wet sponge, then isolation and ligation of the offending vein.

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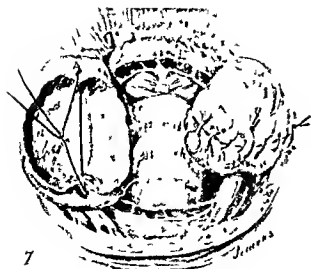


Fig 7 After as much thyroid as is deemed advisable is excised on each side, the upper pole is united with the lower and the raw edges inverted

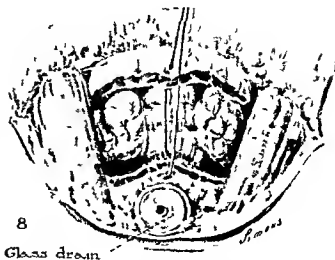


Fig 8 The thyroid stumps have been sutured. The thyroid strap muscles are being united. A glass drain is placed at the most dependent portion of the incision

even considered in the list of possibilities. In cases of thyrotoxicosis, the decreased viscosity of the blood and the delayed coagulability are thought responsible for this state. In cases of ordinary endemic goiter, cutting through the glandular thyroid substance during the operation may result in sufficient absorption to produce a sort of temporary artificial traumatic hyperthyroidism (2). These observations have led recently to the empirical use of thyroid extract as a preventative of postoperative thrombosis and embolism. The method, however, has not met with success in this clinic.

E. Postoperative hypothyroidism occurs when insufficient thyroid is left behind. Leaving 8 to 15 grams of well functioning tissue (the size of a hazelnut) on each side seems to be sufficient to maintain the body requirements and to avoid this complication. In bad goiters a larger piece must be left. If an insufficiency does occur, feeding of thyroid extract in sufficient amount will correct and prevent the progress of this condition.

F. Injuries of the recurrent laryngeal nerve. In the described technique, where the recurrent nerve is seen and, without being manipulated, its course observed during the operation, its severance is a rarity. Its injury, however, may occur through inadvertent application of a clamp, deep suture, or traction, and is detected at once by a change in voice when the patient is asked to phonate, or frequently by a change in breathing or a rasping reflex cough. It should be relieved immediately by removing the clamp or offending suture. If cut, the ends should be sutured. Unilateral trauma, particularly if incomplete, results in a tem-

porary paralysis or paresis. Complete unilateral severance produces a paralysis of the corresponding vocal cord, but the hoarseness which results disappears in 3 to 6 months, when a compensatory motion and swinging over of the other vocal cord is established. Edema of the nerve results in temporary hoarseness, while its compression by scar tissue corresponds frequently to its severance and is a late complication. It becomes serious if the nerves on both sides are similarly involved. In this case, as when both nerves are cut, and a bilateral abductor paralysis results, phonation may be good but breathing is difficult. If the cricoarytenoideus posticus becomes involved, dyspnea may be marked and tracheotomy essential. Death frequently results from asphyxia subsequent to choking spells or from an aspiration pneumonia.

G. Injuries of the trachea and esophagus are usually rare but quite serious. They may occur in cases in which the thyroid is large, circular, and very adherent. During the process of separation the trachea may be cut or torn into, an accident favored by a softening of its wall. When detected, and the wound is small, an attempt should be made to suture it and cover with thyroid capsule. If large, tracheotomy may be necessary. If injury is not recognized, an extensive subcutaneous emphysema develops in a few hours, which requires the reopening of the wound and repair of the defect.

Esophageal injuries result from its displacement, thinning of the wall, as well as from the presence of dense adhesions with the thyroid, thus making recognition difficult and at times impos-

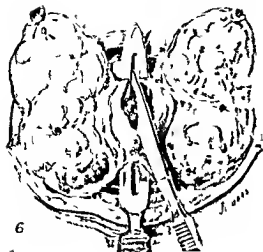


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PHYSIOLOGICAL RECONSTRUCTION OF A THUMB AFTER TOTAL LOSS

STEFRIEN BUNNELL, M.D. SAN FRANCISCO

IN the function of a hand, motion and sensation are of equal importance and this is especially true of a thumb. The hand which is our sense organ of stereognosis is guided in its work by muscle, joint, pain, and temperature sense and by the sense of touch. We are all familiar with how awkward and useless our hand becomes when numbed with cold. When the nerves to the digits are severed the handicap to the workman is great. He is awkward and fumbles and drops objects. His hands are like the legs of a man with locomotor ataxia and cannot functionate without visual guidance. Therefore the thumb to be reconstructed should have if possible normal sensation.

If the two volar nerves to a finger are severed that finger becomes practically useless. An annular scar still further wrecks a digit by curtailing also its lymph and blood supply. Trophic atrophy and loss of function result. If then a thumb is reconstructed by transplanting to the hand a digit from the other hand or the foot, or from a tubular pedicle skin graft taken from the abdomen and stiffened by a bone graft there will follow trophic atrophy equivalent to that seen in a digit that has an annular scar at its base.

In some cases the reconstructed thumb will acquire a slight degree of sensation, but it will be greatly limited and not to the degree of stereognosis. A finger with volar nerves cut is permanently anæsthetic. Recently, I saw one that was still anæsthetic from severance of a volar digital nerve in the palm 20 years previously.

Strangely enough a little better sensation will be acquired in a whole finger grafted on or one made from a tubular skin pedicle, than will follow in a finger after the two volar nerves have been severed. This is apparently because more free nerve endings start to grow down the new digit. On the other hand, when the two main nerves alone are severed these become sealed by neuromata, and the unsevered minor nerves already have their normal terminations, so that no free nerve ends are available to grow down the finger.

Unless we graft the natural nerve supply with a digit or suture the two volar nerves of the new digit to those at the base of the lost digit, the proper degree of sensation and trophic influence will not be acquired. Also, if our reconstructed digit is made from abdominal skin it will lack

the specialized touch corpuscles present in a finger so it can never acquire stereognosis to a better degree than that poor quality present in abdominal skin. To test this, press a penknife against the abdominal wall and try to identify it. A prosthesis as a substitute for a thumb is usually discarded as it has no motion and no sensation.

Other requisites to be sought for in reconstructing a thumb are strength, durability, mobility, and the functioning position of opposition. The latter depends in the case of a movable thumb on the proper balance of the muscles and this is best obtained by attaching the normal muscles and tendons to the new thumb and in their normal relation.

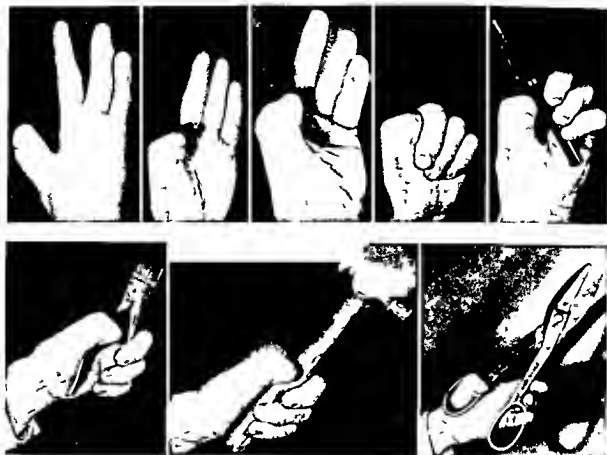
In the reconstruction of the thumb to be described, the normal nerve and vascular supply were preserved and all of the muscles and tendons of the old thumb were attached in their former arrangement to the new thumb. These principles which have not been carried out in the previously reported cases of thumb reconstruction in our literature are offered as sufficiently important to be adopted whenever possible.

Case of H. W. W. aged 49 years. A year previously a circular saw amputated the thumb through its carpometacarpal joint and the index finger through its proximal phalanx. Patient had not been able to work at his trade of carpenter since the accident.

All structures necessary for making a new thumb were present and fortunately were then of no benefit to him as they were non-functioning. They consisted of the following: There was a long enough portion of the second ray



Fig. 1. Showing condition of hand before reconstruction. The thumb has been amputated through its carpometacarpal joint and also the index finger as frequently happens through its proximal phalanx. The hand is unfit for work.



Figs 2 to 9 Showing results of physiological reconstruction of thumb from remains of index finger and second metacarpal. Normal nerve and blood supply have been preserved and all of the tendons and muscles of the index finger and thumb have been attached to the new digit. The thumb has movement strength and normal sensation including stereognosis.

for good length of thumb composed of the second metacarpal and half the proximal phalanx of the index finger. This had attached to it two flexor and two extensor tendons which could act on the metacarpophalangeal joint and also on the new joint to be constructed between the base of the second metacarpal and the trapezium. In addition he had normal blood lymph and nerve supply for the new thumb which could be preserved. He also had the normal specialized sense organs of the skin of the hand which convey impressions of stereognosis in a refined way. For attachment to the transplanted member were all five muscles of the thenar eminence with their normal nerve supply, the long flexor tendon of the thumb and the three extensor tendons also the four tendons of the index finger. Thus eight tendons and five thenar muscles which were already balanced were more than ample for stability and strength and most of them were already educated for use in thumb function.

Operation. April 10, 1929. Skin flaps were so constructed that a flap from the dorsum of the hand was utilized to close in the raw surface of the newly constructed thumb. Another flap from the palm was made to cross the bottom of the

cleft between the new thumb and the hand so as to maintain the depth of the cleft.

The old scars in the hand were excised. The two tender neuromata of the nerves to the amputated thumb and the two to the amputated index finger were dissected out and cut off after the main trunks had been ligated and injected with alcohol to prevent reformation of neuromata.

The remains of the index ray which consisted of half the proximal phalanx, the two flexor and extensor tendons, nerves, and blood vessels and the metacarpal were transplanted *en masse* to the position of a thumb, ample blood supply being left in the posterior and anterior pedicles. The proximal end of the second metacarpal was disarticulated from the carpus and transplanted to the trapezium to form the new joint. With it was taken the lower 3 inches of the tendon of the extensor carpi radialis longus, and this was passed through drill holes in the trapezium and meta

carpal so as to encircle the joint and to stabilize it against dislocating. The upper or muscle end of this same tendon was fastened in the forearm to the extensor carpi radialis brevis tendon for added strength of extension of the hand. The surface of the second metacarpal is well adapted to rest on the saddle of the trapezium and in the correct rotation for opposition.

The original three extensor tendons of the thumb were united to their respective sides at the base of the transplanted metacarpal by passing the sutures through a drill hole in this bone. Good osteoperiosteal and tendon contact was established. The original flexor tendon of the thumb was dissected out and united to the two flexor tendons of the index finger so as to give added strength of flexion to the new thumb.

In the transplantation of the index finger the volar digital nerve to the second interdigital cleft was slit longitudinally up to the base of the palm, so that sensation would be preserved both on the radial side of the long finger and the ulnar side of the index finger. The fork of the volar artery to this cleft was cut and ligated on the long finger side to give richer blood supply to the new thumb. The posterior interosseous muscles in the first and second cleft were preserved with their same attachments and the anterior interosseous muscle in the second cleft was also preserved with its attachment. All the small thenar muscles were dissected out and attached to the metacarpal of the new thumb.

The new thumb was completely enclosed in skin by the flaps from the dorsum and palm of the hand. Eventually there was a denuded area about 1 inch wide and $5\frac{1}{2}$ inches long running obliquely across the dorsum of the hand through the newly constructed cleft and around across the palm. This was filled in with a whole thickness Wolfe graft taken from the skin of the abdomen. Rubber sponge pressure was used in the dressing.

Result. The action of the wrist and remaining three fingers is normal. The newly constructed thumb has movement. It can touch the full length of the long finger and the base and tip of the ring finger. It can spread $1\frac{1}{2}$ inches from the base of the long finger and makes possible an open grasp. It has the ability to oppose the other fingers, in that patient can place the thumb in a position forward from the hand in grasping. It adducts to the center line of the long finger.

The thumb has two movable and stable joints, a metacarpotrapezoid and a distal joint. The latter which formerly was the proximal joint of the index finger, has 25 degrees of motion and is in a functioning position. The thumb is exceedingly strong in all its movements as it has the combined strength of the index finger and thumb, thus having eight functioning tendons instead of the normal four. It is also controlled in its movements by the thenar muscles attached to its metacarpal and functioning

A feature of great importance is that the new thumb has natural sensation and vascularity, as the nerves and blood vessels have been transplanted with it. With the faculty of stereognosis it is most valuable to the patient in his work. The hand is covered with good skin throughout, is free from deforming cicatrices, and is painless. Patient is now again able to pursue his trade of carpentry.

A brief review of the methods that have been used in reconstructing thumbs follows.

In cases in which the metacarpal remains, a deep cleft has been established between the thumb and the second metacarpal—phalangization—(Huguier in 1852, Verrall, Arana, Perthes). The metacarpal, but not the carpal origin of the two adductor muscles of the thenar eminence, must be detached and the lining of the cleft is made by swinging skin flaps into it, or by supplying skin from elsewhere as practiced by Thiersch and Wolfe or by supplying pedicle grafts. The cleft has been further widened by removing the second metacarpal (Perthes, in a girl who lost five digits).

The index or long fingers together with a part or the whole of the metacarpal have been transplanted to the stump of the metacarpal of the thumb or to the trapezium, but without conservation of all nerves, tendons, and muscles (Perthes, Verrall, two cases in 1919, no joining of tendons or nerves, Dunlop, in 1923 used pedicle skin from abdomen for the cleft, Huguier).

The little finger (Wierzejewski) and the index finger have been rotated by means of osteotomy through the metacarpal into a position to oppose the thumb or the hand, or to oppose each other (Lauenstein, 1880, Perthes).

In cases of loss of index and long fingers the thumb has been made to approximate the little finger by altering the direction of its metacarpal and deepening the cleft (Klapp, 1912, Lyle).

Transplantations of new digits from a distance to substitute for a thumb have been made from the ring finger of the other hand and from the second toe (Nicoladoni, 1898, tendon function retained, Joyce, 1917, two cases from ring finger, von Eiselsberg, Krause, Klimm, etc. The method was condemned by Moreston at the International Surgical Congress, New York, 1914).

New thumbs have been made from pedicle skin grafts, tubular or not, from the abdomen and stiffened by a bone graft from the tibia, contacted to or driven into the carpus (Nicoladoni, 1897, Schepelmann, Ritter, Payre, Albee, Pierce).

In case of loss of the fingers, a digit or post for the thumb to work against has been reconstructed on the stump of the hand by the pedicle skin graft and bone graft method (Albee, 1919, two cases, skin flap from shoulder with part of clavicle, flap from chest, and bone from tibia).

In total loss of the hand an offset was reconstructed on the side of the radius which worked against the ulna by the motion of pronation (Henry, 1928). Also a cleft has been made between the radius and ulna so these units could work against each other by their own muscles in a pincher action like the mouth of a crocodile (Krukenberg).

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CARCINOMA OF THE CERVIX

A STUDY OF CASES TREATED AT THE FREE HOSPITAL FOR WOMEN BETWEEN 1875 AND 1929

MARSHALL K. BARTLETT, M.D., AND GEORGE VAN S. SMITH, M.D., BOSTON

THE object of this study was to determine the results of treatment of patients suffering from carcinoma of the uterine cervix, correlating the type of treatment and the stage of the disease when seen. A minimum of attention has been given to age, symptoms, and past and family histories. These factors have been thoroughly treated in previous papers and an analysis of these factors in this series would add little to generally accepted statistics.

Between November, 1875, and January, 1929, 673 cases of carcinoma of the cervix were seen in this hospital and in the private practices of William P. Graves and Frank A. Pemberton. The division of this series into groups according to methods of treatment is shown in Table I.

TABLE I—CARCINOMA OF THE CERVIX

| Method of treatment | Cases |
|---------------------------------------------------------|-------|
| Radium alone | 289 |
| Complete hysterectomy | 114 |
| Complete hysterectomy followed by radium | 45 |
| Radium followed by complete hysterectomy | 10 |
| Vaginal hysterectomy | 14 |
| Palliative supravaginal hysterectomy | 2 |
| Palliative supravaginal hysterectomy followed by radium | 2 |
| Radium followed by palliative supravaginal hysterectomy | 1 |
| Radical excision of cervical stump | 4 |
| Radium followed by radical excision of cervix | 2 |
| Amputation of cervix | 21 |
| Amputation of cervix followed by radium | 2 |
| Curette and cautery | 121 |
| No treatment | 46 |
| Total | 673 |

In the subdivision shown in Table I, cases listed as "complete hysterectomy" include both Wertheim hysterectomies and those described as simple complete hysterectomies. A review of the operative descriptions in these cases seemed to make this distinction entirely artificial in many cases, and it was finally discarded entirely.

For the purpose of classifying our results, patients in this series have been divided into 7, 5, and 3 year groups. The 7 year group includes all cases treated at least 7 years previous to this writing who are traceable 7 years or more, or until death. Similarly, the 5 year group includes all cases treated before January, 1925, who can be traced at least 5 years. The 3 year group com-

prises cases treated previous to January, 1927, and traceable 3 years or more. No gross statistics for the entire series have been calculated, as figures on a heterogeneous group treated by various types of procedure, both obsolete and modern, seem quite misleading.

The classification of the American College of Surgeons has been followed in grouping cases according to the stage of the disease.

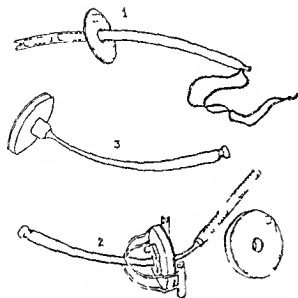
- A Disease limited to cervix
- B Disease involving cavity or vaginal wall,
- C Disease involving broad ligaments
- D Wide fixation. Remote metastases

- 1 Primary case
- 2 Recurrence in vaginal wall following panhysterectomy or radium for cancer,
- 3 Recurrence deep in pelvis following panhysterectomy,
- 4 Carcinoma of cervix following supracervical hysterectomy for carcinoma of the cervix

Radium, first used in this hospital in 1916, is in the form of a salt, the bromide. This is in glass capsules enclosed in silver capsules 0.5 millimeter in thickness. The usual dosage in carcinoma of the cervix is 200 or 225 milligrams for 24 hours. The dosage has been varied from 100 to 225 milligrams for from 2 to 36 hours. More than 100 milligrams have not been left *in situ* for more than 30 hours.

The original method of application was to place part of the radium, usually 100 milligrams, into a rubber tube which was inserted into the cervical canal. The remainder of the radium was applied to a silver dollar or a fifty cent piece through which a hole had previously been drilled to admit the passage of the rubber tube. The disc was then covered with rubber dam, slipped over the rubber tube, and its radium brought into close contact with the diseased cervix. This form of applicator is illustrated (Fig. 1).

A more recent method of application is by use of the Smith applicators (Figs. 2 and 3), which are made entirely of brass 1 millimeter in thickness. The tube is mounted on a flexible copper handle and fits into the cervical canal. The pill-box, of either a dollar or fifty cent size, slips over the handle and comes to rest against the cervix. The pinwheel applicator, in either its two or four winged form, is occasionally used to gain greater radiation to the parametria or vaginal fornices.



Figs 1, 2 and 3

Recently the entire applicator has been coated with paraffin before insertion into the patient, to eliminate secondary beta radiation from the brass containers.

In preparation for the application of radium, when there is an excessive amount of malignant tissue present, a curettage and cauterization is performed. No hesitancy is felt at this hospital in undertaking this procedure, as careful analysis of cases with and without curettage and cauterization before radiation has failed to reveal any appreciable difference either in convalescence or in duration of life after operation. This is usually done from 10 days to 2 weeks before the application of radium. All curettages are, of course, examined microscopically to establish the diagnosis. In cases in which there is no gross excess of malignant tissue, previous curettage and cauterization is not done. In these cases careful biopsy is always done at the time of radium application.

No family history was available on the 85 private cases in this series. Of the remaining 588 patients, 61, or 10.4 per cent, gave a family history of malignant disease.

Forty-seven married patients and 25 single patients gave no history of pregnancy, a total of 10.7 per cent of the entire series. An additional 33, or 4.9 per cent, gave a history of abortions and miscarriages, but no full term pregnancy.

Previous supravaginal hysterectomy had been performed on 27 patients in this series. Eight of these cases are judged to have had carcinoma of the cervix at the time hysterectomy was performed. Thus cancer was probably present in

29.6 per cent of these cases at the previous operation. Eleven of the above 27 patients were operated upon in this hospital. Of these, one probably had cervical carcinoma at the time of operation.

To reduce this incidence of undetected early carcinoma, it is necessary to make a careful routine microscopic examination of all cervical curettages and trachelorrhaphy specimens. This is done at this hospital and 16 cases of early unsuspected cervical cancer have been detected. These patients were all treated with radium, with one exception. All but 2 of them are alive and well, the postradiation interval varying from a few months to 10 years. Of the two who are dead, one was a Class D case when she finally received radium 4 years after the original trachelorrhaphy specimen was removed. She survived radiation 2 months. The other received radium 1 year and 2 months after biopsy, was classified as Group B at that time, and survived only 4 months. One case had a complete hysterectomy and is well 10 years after operation.

Cauterization of the cervix, as done at this hospital, seems to be a fairly sure prophylaxis against later carcinoma. Approximately 1,700 cervixes were cauterized between 1914 and January, 1929. No one of these patients is known to have later developed carcinoma of the cervix. A history of previous cauterization was obtained in only 1 of the 673 cases in this series. This one patient had had a cauterization done 5 months before complete hysterectomy for carcinoma of the cervix was performed. Judging from the condition at operation, the malignancy was probably present at the time of the cauterization.

In 560 of the cases in this series, the diagnosis of carcinoma was established microscopically. The remaining 113 were clinically unmistakable. Of these, 84 were seen previous to 1907, when microscopic examination was not a routine procedure.

On microscopic examination, 494 were classified as squamous and 66 as adenocarcinoma, a ratio of 7.5 to 1.

Pyometra was found as a complicating factor in 19 cases. In 17 of these cases, however, the condition was present at the first operation, constituting a complication of the disease rather than of the treatment. Stenosis of the cervix, following radium treatment, with consequent pyometra was the condition found in the 2 other cases. This was found at a second operation with application of radium for recurrence 3 and 9 months after the first radiation. Of the 289 cases treated by radium, only these 2, or 0.69 per cent, developed pyometra.

There were 26 operative deaths in this series, as shown in Table II

TABLE II—OPERATIVE DEATHS

| Operation | Total | Deaths | Per cent |
|------------------------------------|-------|--------|----------|
| Curettage and cauterization | 121 | 5 | 4.1 |
| Amputation of cervix | 93 | 1 | 1.1 |
| Radical excision of cervical stump | 4 | 1 | 25.0 |
| Complete hysterectomy | | | |
| 1 Before 1902 | 14 | 9 | 64.3 |
| 2 1902-1929 | 155 | 10 | 6.5 |
| 3 Total | 169 | 19 | 11.2 |

The figure of 11.2 per cent for operative mortality for abdominal hysterectomy in this series is considerably lower than that given by Lane-Clayton, in a review of the existing literature on this subject, published in 1927. She found the total operative mortality 17.3 per cent for this operation on 11,880 cases.

RESULTS

Radium alone The results of treatment of carcinoma of the cervix by radium alone are shown in Table III. The cases are divided into 3, 5, and 7 year groups as described above.

TABLE III—RADIUM ALONE

| Group | A | B | C | D | Total |
|---------------------|------|------|------|-----|-------|
| Traceable 7 years | 2 | 6 | 41 | 42 | 91 |
| 7 year Survivals | 2 | 0 | 1 | 1 | 4 |
| Survival per cent | 100 | 0 | 2.4 | 2.4 | 4.4 |
| Traceable 5 years | 5 | 11 | 69 | 58 | 143 |
| 5 year Survivals | 4 | 3 | 8 | 7 | 32 |
| Survival per cent | 80 | 27.3 | 11.6 | 3.5 | 11.9 |
| Traceable 3 years | 18 | 15 | 100 | 82 | 215 |
| 3 year Survivals | 16 | 9 | 23 | 6 | 54 |
| Survival per cent | 88.9 | 60 | 23 | 7.3 | 25.1 |
| Traceable 0-3 years | 15 | 2 | 24 | 20 | 61 |
| Survivals | 15 | 1 | 20 | 11 | 47 |
| Survival per cent | 100 | 50 | 83.3 | 55 | 77 |

Complete hysterectomy The results of cases treated by complete hysterectomy are shown in Table IV.

TABLE IV—COMPLETE HYSTERECTOMY

| Group | A | B | C | D | Total |
|---------------------|------|------|-----|------|-------|
| Traceable 7 years | 28 | 4 | 35 | 13 | 80 |
| 7 year Survivals | 10 | 0 | 1 | 1 | 12 |
| Survival per cent | 57.1 | 0 | 2.9 | 7.7 | 22.5 |
| Traceable 5 years | 35 | 4 | 36 | 14 | 89 |
| 5 year Survivals | 26 | 0 | 2 | 1 | 29 |
| Survival per cent | 74.3 | 0 | 5.6 | 7.1 | 32.6 |
| Traceable 3 years | 46 | 6 | 37 | 14 | 103 |
| 3 year Survivals | 41 | 1 | 8 | 2 | 47 |
| Survival per cent | 89.1 | 16.7 | 3.1 | 14.3 | 45.6 |
| Traceable 0-3 years | 5 | 0 | 5 | 0 | 10 |
| Survivals | 5 | 0 | 0 | 0 | 5 |
| Survival per cent | 100 | 0 | 0 | 0 | 50 |

Complete hysterectomy followed by radium The results of cases treated by this method are shown in Table V.

TABLE V—COMPLETE HYSTERECTOMY FOLLOWED BY RADIUM

| Group | A | B | C | D | Total |
|---------------------|------|----|------|---|-------|
| Traceable 7 years | 4 | 4 | 16 | 4 | 28 |
| 7 year Survivals | 2 | 2 | 4 | 0 | 8 |
| Survival per cent | 50 | 50 | 25 | 0 | 28.6 |
| Traceable 5 years | 0 | 4 | 21 | 4 | 38 |
| 5 year Survivals | 4 | 2 | 6 | 0 | 12 |
| Survival per cent | 44.4 | 50 | 28.6 | 0 | 31.6 |
| Traceable 3 years | 0 | 5 | 25 | 4 | 39 |
| 3 year Survivals | 7 | 2 | 8 | 0 | 17 |
| Survival per cent | 77.8 | 40 | 38.1 | 0 | 43.6 |
| Traceable 0-3 years | 0 | 0 | 1 | 0 | 1 |
| Survivals | 0 | 0 | 0 | 0 | 0 |
| Survival per cent | 0 | 0 | 0 | 0 | 0 |

Radium followed by complete hysterectomy Ten cases were treated by this method, all more than 7 years previous to January, 1929. Six of these died less than 3 years after operation. Of these, 5 were Class C and the other Class D at the time of operation. Two Class A cases and one Class C patient survived the 3 year interval, 30 per cent. One Class A and one Class C case survived 5 years, 20 per cent. One case when last heard from was living, less than 3 years after operation.

Gross figures for complete hysterectomy and radium Combining the four preceding groups into one to give the results in cases treated by radium or complete hysterectomy, we obtain the figures shown in Table VI.

TABLE VI—RADIUM OR HYSTERECTOMY OR BOTH

| Group | Total |
|---------------------|-------|
| Traceable 7 years | 208 |
| 7 year Survivals | 30 |
| Survival per cent | 14.4 |
| Traceable 5 years | 279 |
| 5 year Survivals | 60 |
| Survival per cent | 21.5 |
| Traceable 3 years | 366 |
| 3 year Survivals | 121 |
| Survival per cent | 33.1 |
| Traceable 0-3 years | 73 |
| Survivals | 53 |
| Survival per cent | 72.6 |

RADIUM VERSUS HYSTERECTOMY

It is generally conceded that in any but very early cases of carcinoma of the cervix radium is preferable to surgical excision as a method of treatment. The operative mortality must always be kept in mind in comparing these two groups. As shown, the operative deaths associated with complete hysterectomy in this series were 11.2 per cent. Excluding cases previous to 1902, the operative mortality was 6.5 per cent for this operation.

Radium for carcinoma of the cervix in this hospital is practically always applied under ether anaesthesia. In this series 289 cases were treated

by radium alone. Not one operative death occurred in this group.

In view of the foregoing it is interesting to tabulate once more the comparative results of radium and complete hysterectomy. These figures include operative deaths.

TABLE VII—RADIUM AND COMPLETE HYSTERECTOMY

| Group | Radium | Complete hysterectomy |
|----------------------------------------|-------------|-----------------------|
| Traceable 7 years Survival per cent | 91 4.4 | 80 22.5 |
| Traceable 5 years Survival per cent | 141 11.9 | 89 32.6 |
| Traceable 3 years Survival per cent | 215 25.1 | 101 45.6 |

It is interesting to compare these figures with those given by Lane Claypon for 5 year survivals. In her analysis patients dying of causes other than cancer are deducted from the series. In computing our figures we have considered all deaths as due to carcinoma.

Lane Claypon gives 18.3 per cent 5 year survivals of patients treated by abdominal hysterectomy as compared with 32.6 per cent in this series. She found 22 per cent 5 year survivals after radiation. In this series 11.9 per cent passed the 5 year interval after radium treatment. Of the cases of carcinoma of the cervix treated at the Mayo Clinic, by radium and X ray, between 1915 and 1924, 23.15 per cent survived the 5 year interval. Selecting from the above group the early, or Class A cases and tabulating them, the comparison shown in Table VIII is obtained.

TABLE VIII—CLASS A EARLY CASES

| Gr. p. | Radium | Complete hysterectomy |
|----------------------------------------|------------|-----------------------|
| Traceable 7 years Survival per cent | 2 100 | 25 57.1 |
| Traceable 5 years Survival per cent | 5 80 | 35 74.3 |
| Traceable 3 years Survival per cent | 18 85.9 | 46 80.1 |

The question of late recurrences after radium treatment or hysterectomy is an interesting one. It is generally thought that late recurrence is more prone to occur following radium than after complete hysterectomy. One explanation offered is that the so called late recurrence after radium is not a recurrence of the original cancer but a new neoplasm, a result of the radiation.

Here again, the results of this analysis seem at variance with the usual concepts. Fifty-two Class A cases had complete hysterectomies. Of these, 35 were traceable for 5 years and 28 for 7 years or longer. Four known late recurrences were

found. The postoperative intervals were 5, 3, 8, and 11 years in these 4 cases. Of the 33 Class A cases treated by radium, 5 were traceable for 5 years but only 2 for 7 or more years. None of these cases has developed recurrence as yet.

Vaginal hysterectomy for carcinoma of the cervix has not been done in this hospital since 1900 there were 11 traceable cases in this group. Nine patients died 8 months or less after operation, 2 being operative deaths. Two were living with recurrence 4 and 7 months after operation, while one, a Class A case, was living and well 11 years and 5 months after operation.

Palliative supravaginal hysterectomy. The palliative supravaginal hysterectomy was performed in 2 Class D cases. One survived 2 years and 8 months and the other died 4 years after operation.

Palliative supravaginal hysterectomy and radium. Palliative supravaginal hysterectomy followed by radium was the treatment of 2 cases. One died 11 months after operation and the other was living with recurrence 2 years after operation. These cases were both graded as Class C at operation.

This same combination of treatment in reverse order, was used on one Class C patient. She died 1 year, 5 months after operation.

Radical excision of the cervical stump for carcinoma of the cervix after supravaginal hysterectomy was performed on six cases. One is untraceable. One, Class 4 D, died 5 months after operation. Radium was combined with the surgical procedure in these 2 cases. The 4 others were Class 4 A. There was one operative death. One died 1 year, 3 months after operation, and the 2 others are well 3 years, 6 months, and 5 years, 6 months after operation.

Amputation of the cervix. Five Class A patients received this form of treatment, all previous to 1910. Three died 13, 19, and 27 years after operation respectively. Two are living 24 and 41 years after operation.

Of the 2 Class B cases so treated, 1 died 1 year, 2 months, and 1 is living 22 years after operation. Biopsy had been performed on these cases with long survival intervals.

There were 12 Class C patients treated by this method. Three are untraceable. There was 1 operative death. Four died from 7 months to 2 years, 11 months after operation. Four were living when last traced, the longest period after operation being 1 year, 3 months.

Two Class D patients were treated. One is untraceable and the other died 1 year, 6 months after operation.

Amputation of the cervix followed by radium was the procedure in 2 cases. One patient, Class A,

A METHOD FOR THE PRE-OPERATIVE DETERMINATION OF THE BEST FUNCTIONAL POSITION FOR AN ANKYLOSED HIP

A PRELIMINARY REPORT¹

ALFREDO ADAMS AND SIOKANE WASHINGTON

A CAREFUL study of all cases of unilateral ankylosis of the hip that have been treated in the Shriners' Hospital for Crippled Children, has led to the conclusion that the best functional position for an ankylosed hip in a child is one of 20 to 25 degrees flexion, less than 18 degrees abduction, and slight external rotation of the extremity.

In a discussion of the operative procedures for stabilizing the hip, the question of position is usually dismissed with the statement that the extremity should be placed in a position of flexion and abduction, the degree of abduction being governed by the amount of shortening. Little emphasis is placed upon the exact degree of flexion and abduction that should be present. In cases I have had an opportunity to observe, there is a definite position for each individual which would give the best functional result and a few degrees variation in any direction may be of extreme importance.

It is the object of this paper to present a simple method whereby the operator may, before operation, determine the best position for the individual case under consideration. The subject is best described by separating it into the natural subdivisions of flexion, abduction, rotation, and apparent shortening.

FLEXION

The above statement that 20 to 25 degrees flexion offers the best functional result will probably meet with some disapproval, since it is less than the figures usually given. The cases that I have observed were all children under 17 years of age, who were leading an active life and were spending the usual amount of time in school. Those with 20 to 25 degrees flexion, provided the angle of abduction was correct, were able to walk with very little limp and could assume a very satisfactory sitting position (Fig 6). There was not a single patient who complained of pain in the back after sitting. Most of these children could climb stairs in the normal manner, by giving a little jump when stepping up with the foot on the involved side. The only handicap that was generally experienced, was an inability to lace the shoe.

In those patients in which the degree of flexion was more than 25 degrees, a lump and lordosis became noticeable and in some there was a complaint of pain in the lumbar spine after walking.

In 1883 Kingsley described a method for determining the degree of flexion deformity of a hip which I have found to be more accurate and convenient than the use of a goniometer. He located a point on the lateral side of the extremity which was 24 inches from the trochanter (line A B, Fig 1) and with the lumbar spine flat and the knee extended, he measured the distance of this point from the table (line B C). By referring to Table I, one readily finds the angle of flexion that corresponds to this measurement. A few of these measurements can be easily memorized so that it is not always necessary to have the table available.

ABDUCTION

The fact that abduction of a hip will decrease the apparent shortening of the lower extremity and that adduction will increase the apparent shortening is well understood. It is therefore evident that the degree of abduction must be governed solely by the amount of real shortening present.

The patients I have observed who have had the proper amount of flexion and an abduction of 18 degrees or less, walk with a very satisfactory gait when provided with a lift under the extremity that is one half inch less than the apparent shortening present. In cases with the angle of abduction more than 18 degrees the compensatory scoliosis becomes very noticeable and the patient walks with the feet wide apart.

In 1888 Lovett published a method by which the degree of abduction or adduction of a hip could be determined if the difference between the real and apparent shortening and the width of the pelvis were known. I have found this method exceedingly useful and while the results check very closely with measurements taken with a goniometer, upon repeated examination they are more constant. When Lovett's table (Table II) is to be consulted, the measurements should be taken when the patient is lying on his back, with the head, chest, umbilicus, and feet in alignment and with the feet not more than 2 inches apart.

¹From Shriners' Hospital for Crippled Children and Department of Surgery Washington University Medical School St. Louis, Missouri.

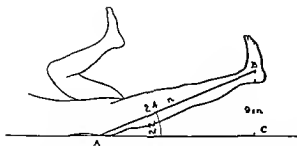


Fig. 1 Author's modification of Kingsley's method of measuring a patient in order to determine the degree of flexion of an ankylosed hip

If the feet are separated the apparent shortening is altered

I have elected to measure from the umbilicus and anterior superior spine to the sole of the foot rather than to the internal malleolus. This point is selected on account of the marked difference in measurements from the internal malleolus to the sole of the foot on the two sides in cases in which there is considerable atrophy of the involved extremity. When the apparent shortening exceeds the real shortening, the extremity is adducted and if the real shortening exceeds the apparent shortening it is abducted.

Lovett's method for determining abduction or adduction cannot be used with the same accuracy in cases in which there is a marked knock knee associated with an adducted hip. This condition is frequently seen, for in cases in which the hip is markedly adducted, a knock knee is often a compensatory development. This deformity permits a lowering of the anterior superior spine which in turn results in a decrease in the apparent shortening. Therefore, the degree of adduction as determined by this table is less than that which actually exists.

I have attempted to measure accurately the angle of abduction or adduction of a hip on X-ray plates (Fig. 8), by drawing one line across the plate passing through the lowest points of the sacro iliac joints and a second line superimposed on the femur and measuring the angle at which these lines cross with a protractor. The results obtained in this manner correspond very closely with those obtained by Lovett's method provided considerable care is taken at the time these plates are taken. The patient must be placed on the X-ray table with the pelvis level in both planes. This may be accomplished by elevating the extremity of the involved side to compensate for the amount of flexion present. The X-ray tube must be focused over the involved hip. If these precautions are not carried out, the angle of flexion that is present will result in an X-ray in which the

TABLE I—FOR ESTIMATING THE DEGREE OF FLEXION

| De grees | De grees | De grees | De grees |
|--------------|--------------|--------------|--------------|
| 0 5 inches | 6 5 inches | 12 5 inches | 18 5 inches |
| 1 0 inches | 7 0 inches | 13 0 inches | 19 0 inches |
| 2 5 inches | 7 5 inches | 13 5 inches | 19 5 inches |
| 3 0 inches | 8 0 inches | 14 0 inches | 20 0 inches |
| 3 5 inches | 8 5 inches | 14 5 inches | 20 5 inches |
| 4 0 inches | 9 0 inches | 15 0 inches | 21 0 inches |
| 4 5 inches | 9 5 inches | 15 5 inches | 21 5 inches |
| 5 0 inches | 10 0 inches | 16 0 inches | 22 0 inches |
| 5 5 inches | 10 5 inches | 16 5 inches | 22 5 inches |
| 6 0 inches | 11 0 inches | 17 0 inches | 23 0 inches |
| 6 5 inches | 11 5 inches | 17 5 inches | 23 5 inches |
| 7 0 inches | 12 0 inches | 18 0 inches | 24 0 inches |
| 7 5 inches | 12 5 inches | 18 5 inches | 24 5 inches |
| 8 0 inches | 13 0 inches | 19 0 inches | 25 0 inches |
| 8 5 inches | 13 5 inches | 19 5 inches | 25 5 inches |
| 9 0 inches | 14 0 inches | 20 0 inches | 26 0 inches |
| 9 5 inches | 14 5 inches | 20 5 inches | 26 5 inches |
| 10 0 inches | 15 0 inches | 21 0 inches | 27 0 inches |
| 10 5 inches | 15 5 inches | 21 5 inches | 27 5 inches |
| 11 0 inches | 16 0 inches | 22 0 inches | 28 0 inches |
| 11 5 inches | 16 5 inches | 22 5 inches | 28 5 inches |
| 12 0 inches | 17 0 inches | 23 0 inches | 29 0 inches |
| 12 5 inches | 17 5 inches | 23 5 inches | 29 5 inches |
| 13 0 inches | 18 0 inches | 24 0 inches | 30 0 inches |
| 13 5 inches | 18 5 inches | 24 5 inches | 30 5 inches |
| 14 0 inches | 19 0 inches | 25 0 inches | 31 0 inches |
| 14 5 inches | 19 5 inches | 25 5 inches | 31 5 inches |
| 15 0 inches | 20 0 inches | 26 0 inches | 32 0 inches |
| 15 5 inches | 20 5 inches | 26 5 inches | 32 5 inches |
| 16 0 inches | 21 0 inches | 27 0 inches | 33 0 inches |
| 16 5 inches | 21 5 inches | 27 5 inches | 33 5 inches |
| 17 0 inches | 22 0 inches | 28 0 inches | 34 0 inches |
| 17 5 inches | 22 5 inches | 28 5 inches | 34 5 inches |
| 18 0 inches | 23 0 inches | 29 0 inches | 35 0 inches |
| 18 5 inches | 23 5 inches | 29 5 inches | 35 5 inches |
| 19 0 inches | 24 0 inches | 30 0 inches | 36 0 inches |
| 19 5 inches | 24 5 inches | 30 5 inches | 36 5 inches |
| 20 0 inches | 25 0 inches | 31 0 inches | 37 0 inches |
| 20 5 inches | 25 5 inches | 31 5 inches | 37 5 inches |
| 21 0 inches | 26 0 inches | 32 0 inches | 38 0 inches |
| 21 5 inches | 26 5 inches | 32 5 inches | 38 5 inches |
| 22 0 inches | 27 0 inches | 33 0 inches | 39 0 inches |
| 22 5 inches | 27 5 inches | 33 5 inches | 39 5 inches |
| 23 0 inches | 28 0 inches | 34 0 inches | 40 0 inches |
| 23 5 inches | 28 5 inches | 34 5 inches | 40 5 inches |
| 24 0 inches | 29 0 inches | 35 0 inches | 41 0 inches |
| 24 5 inches | 29 5 inches | 35 5 inches | 41 5 inches |
| 25 0 inches | 30 0 inches | 36 0 inches | 42 0 inches |
| 25 5 inches | 30 5 inches | 36 5 inches | 42 5 inches |
| 26 0 inches | 31 0 inches | 37 0 inches | 43 0 inches |
| 26 5 inches | 31 5 inches | 37 5 inches | 43 5 inches |
| 27 0 inches | 32 0 inches | 38 0 inches | 44 0 inches |
| 27 5 inches | 32 5 inches | 38 5 inches | 44 5 inches |
| 28 0 inches | 33 0 inches | 39 0 inches | 45 0 inches |
| 28 5 inches | 33 5 inches | 39 5 inches | 45 5 inches |
| 29 0 inches | 34 0 inches | 40 0 inches | 46 0 inches |
| 29 5 inches | 34 5 inches | 40 5 inches | 46 5 inches |
| 30 0 inches | 35 0 inches | 41 0 inches | 47 0 inches |
| 30 5 inches | 35 5 inches | 41 5 inches | 47 5 inches |
| 31 0 inches | 36 0 inches | 42 0 inches | 48 0 inches |
| 31 5 inches | 36 5 inches | 42 5 inches | 48 5 inches |
| 32 0 inches | 37 0 inches | 43 0 inches | 49 0 inches |
| 32 5 inches | 37 5 inches | 43 5 inches | 49 5 inches |
| 33 0 inches | 38 0 inches | 44 0 inches | 50 0 inches |
| 33 5 inches | 38 5 inches | 44 5 inches | 50 5 inches |
| 34 0 inches | 39 0 inches | 45 0 inches | 51 0 inches |
| 34 5 inches | 39 5 inches | 45 5 inches | 51 5 inches |
| 35 0 inches | 40 0 inches | 46 0 inches | 52 0 inches |
| 35 5 inches | 40 5 inches | 46 5 inches | 52 5 inches |
| 36 0 inches | 41 0 inches | 47 0 inches | 53 0 inches |
| 36 5 inches | 41 5 inches | 47 5 inches | 53 5 inches |
| 37 0 inches | 42 0 inches | 48 0 inches | 54 0 inches |
| 37 5 inches | 42 5 inches | 48 5 inches | 54 5 inches |
| 38 0 inches | 43 0 inches | 49 0 inches | 55 0 inches |
| 38 5 inches | 43 5 inches | 49 5 inches | 55 5 inches |
| 39 0 inches | 44 0 inches | 50 0 inches | 56 0 inches |
| 39 5 inches | 44 5 inches | 50 5 inches | 56 5 inches |
| 40 0 inches | 45 0 inches | 51 0 inches | 57 0 inches |
| 40 5 inches | 45 5 inches | 51 5 inches | 57 5 inches |
| 41 0 inches | 46 0 inches | 52 0 inches | 58 0 inches |
| 41 5 inches | 46 5 inches | 52 5 inches | 58 5 inches |
| 42 0 inches | 47 0 inches | 53 0 inches | 59 0 inches |
| 42 5 inches | 47 5 inches | 53 5 inches | 59 5 inches |
| 43 0 inches | 48 0 inches | 54 0 inches | 60 0 inches |
| 43 5 inches | 48 5 inches | 54 5 inches | 60 5 inches |
| 44 0 inches | 49 0 inches | 55 0 inches | 61 0 inches |
| 44 5 inches | 49 5 inches | 55 5 inches | 61 5 inches |
| 45 0 inches | 50 0 inches | 56 0 inches | 62 0 inches |
| 45 5 inches | 50 5 inches | 56 5 inches | 62 5 inches |
| 46 0 inches | 51 0 inches | 57 0 inches | 63 0 inches |
| 46 5 inches | 51 5 inches | 57 5 inches | 63 5 inches |
| 47 0 inches | 52 0 inches | 58 0 inches | 64 0 inches |
| 47 5 inches | 52 5 inches | 58 5 inches | 64 5 inches |
| 48 0 inches | 53 0 inches | 59 0 inches | 65 0 inches |
| 48 5 inches | 53 5 inches | 59 5 inches | 65 5 inches |
| 49 0 inches | 54 0 inches | 60 0 inches | 66 0 inches |
| 49 5 inches | 54 5 inches | 60 5 inches | 66 5 inches |
| 50 0 inches | 55 0 inches | 61 0 inches | 67 0 inches |
| 50 5 inches | 55 5 inches | 61 5 inches | 67 5 inches |
| 51 0 inches | 56 0 inches | 62 0 inches | 68 0 inches |
| 51 5 inches | 56 5 inches | 62 5 inches | 68 5 inches |
| 52 0 inches | 57 0 inches | 63 0 inches | 69 0 inches |
| 52 5 inches | 57 5 inches | 63 5 inches | 69 5 inches |
| 53 0 inches | 58 0 inches | 64 0 inches | 70 0 inches |
| 53 5 inches | 58 5 inches | 64 5 inches | 70 5 inches |
| 54 0 inches | 59 0 inches | 65 0 inches | 71 0 inches |
| 54 5 inches | 59 5 inches | 65 5 inches | 71 5 inches |
| 55 0 inches | 60 0 inches | 66 0 inches | 72 0 inches |
| 55 5 inches | 60 5 inches | 66 5 inches | 72 5 inches |
| 56 0 inches | 61 0 inches | 67 0 inches | 73 0 inches |
| 56 5 inches | 61 5 inches | 67 5 inches | 73 5 inches |
| 57 0 inches | 62 0 inches | 68 0 inches | 74 0 inches |
| 57 5 inches | 62 5 inches | 68 5 inches | 74 5 inches |
| 58 0 inches | 63 0 inches | 69 0 inches | 75 0 inches |
| 58 5 inches | 63 5 inches | 69 5 inches | 75 5 inches |
| 59 0 inches | 64 0 inches | 70 0 inches | 76 0 inches |
| 59 5 inches | 64 5 inches | 70 5 inches | 76 5 inches |
| 60 0 inches | 65 0 inches | 71 0 inches | 77 0 inches |
| 60 5 inches | 65 5 inches | 71 5 inches | 77 5 inches |
| 61 0 inches | 66 0 inches | 72 0 inches | 78 0 inches |
| 61 5 inches | 66 5 inches | 72 5 inches | 78 5 inches |
| 62 0 inches | 67 0 inches | 73 0 inches | 79 0 inches |
| 62 5 inches | 67 5 inches | 73 5 inches | 79 5 inches |
| 63 0 inches | 68 0 inches | 74 0 inches | 80 0 inches |
| 63 5 inches | 68 5 inches | 74 5 inches | 80 5 inches |
| 64 0 inches | 69 0 inches | 75 0 inches | 81 0 inches |
| 64 5 inches | 69 5 inches | 75 5 inches | 81 5 inches |
| 65 0 inches | 70 0 inches | 76 0 inches | 82 0 inches |
| 65 5 inches | 70 5 inches | 76 5 inches | 82 5 inches |
| 66 0 inches | 71 0 inches | 77 0 inches | 83 0 inches |
| 66 5 inches | 71 5 inches | 77 5 inches | 83 5 inches |
| 67 0 inches | 72 0 inches | 78 0 inches | 84 0 inches |
| 67 5 inches | 72 5 inches | 78 5 inches | 84 5 inches |
| 68 0 inches | 73 0 inches | 79 0 inches | 85 0 inches |
| 68 5 inches | 73 5 inches | 79 5 inches | 85 5 inches |
| 69 0 inches | 74 0 inches | 80 0 inches | 86 0 inches |
| 69 5 inches | 74 5 inches | 80 5 inches | 86 5 inches |
| 70 0 inches | 75 0 inches | 81 0 inches | 87 0 inches |
| 70 5 inches | 75 5 inches | 81 5 inches | 87 5 inches |
| 71 0 inches | 76 0 inches | 82 0 inches | 88 0 inches |
| 71 5 inches | 76 5 inches | 82 5 inches | 88 5 inches |
| 72 0 inches | 77 0 inches | 83 0 inches | 89 0 inches |
| 72 5 inches | 77 5 inches | 83 5 inches | 89 5 inches |
| 73 0 inches | 78 0 inches | 84 0 inches | 90 0 inches |
| 73 5 inches | 78 5 inches | 84 5 inches | 90 5 inches |
| 74 0 inches | 79 0 inches | 85 0 inches | 91 0 inches |
| 74 5 inches | 79 5 inches | 85 5 inches | 91 5 inches |
| 75 0 inches | 80 0 inches | 86 0 inches | 92 0 inches |
| 75 5 inches | 80 5 inches | 86 5 inches | 92 5 inches |
| 76 0 inches | 81 0 inches | 87 0 inches | 93 0 inches |
| 76 5 inches | 81 5 inches | 87 5 inches | 93 5 inches |
| 77 0 inches | 82 0 inches | 88 0 inches | 94 0 inches |
| 77 5 inches | 82 5 inches | 88 5 inches | 94 5 inches |
| 78 0 inches | 83 0 inches | 89 0 inches | 95 0 inches |
| 78 5 inches | 83 5 inches | 89 5 inches | 95 5 inches |
| 79 0 inches | 84 0 inches | 90 0 inches | 96 0 inches |
| 79 5 inches | 84 5 inches | 90 5 inches | 96 5 inches |
| 80 0 inches | 85 0 inches | 91 0 inches | 97 0 inches |
| 80 5 inches | 85 5 inches | 91 5 inches | 97 5 inches |
| 81 0 inches | 86 0 inches | 92 0 inches | 98 0 inches |
| 81 5 inches | 86 5 inches | 92 5 inches | 98 5 inches |
| 82 0 inches | 87 0 inches | 93 0 inches | 99 0 inches |
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| 122 5 inches | 127 5 inches | 133 5 inches | 139 5 inches |



Fig 2 V W D 146 Tuberculosis of the left hip with a severe flexion deformity

Fig 3 Front view of same patient as in Figure 2. The anterior superior spines are marked. Note the marked adduction of the left hip and shortening of the left leg

Figs 4 and 5 Front and side views of same patient as in

Figures 2 and 3 after arthrodesis of left hip in a position of 22 degrees flexion and 17 degrees abduction. There is a 1 1/2 inch lift on the left shoe

Fig 6 The very satisfactory sitting position that a patient who has 22 degrees flexion of the hip is able to assume

When Lovett published his table it was with the idea of providing a means by which the amount of abduction or adduction present could be accurately and easily determined. By a reverse process we have used his figures to determine the best functional position to place a lower extremity following operations for stabilization of the hip or operations for correcting a pre-existing deformity.

The first step is to determine the exact amount of real shortening, by measuring the two extremities from the anterior superior spines to the sole of the feet. When taking these measurements, it is essential that the two extremities be placed in the same position regarding flexion and adduction or abduction. Since an extremity will measure slightly longer when in a position of adduction than when abducted, it is evident that the real shortening cannot be found unless the two extremities are measured under like conditions. If, for example, it has been found that the real shortening is 2 inches and it is desired to place the extremity in such a position as to result in an apparent shortening of 1/2 inch, the difference of 1 1/2 inches must be gained by abduction. By referring to Lovett's table (Table II) the angle is found to vary with the width of the pelvis. If the distance



Fig. 7. X ray of case shown in Figure 2. Tuberculosis of left hip in a position of adduction.



Fig. 8. X ray of case shown in Figure 7 after arthrodesis of left hip and bending osteotomy of the femur. Plate shows the extremity in a position of 17 degrees abduction which corresponds with the physical finding.

solid bony ankylosis of the hip following arthritis or those who have had tuberculosis of the hip which was treated first by obtaining a solid ankylosis in wide abduction according to the method described by Abbott and Fischer in their article entitled "Arthrodesis of the Hip" to be published and then later correcting this deformity by an osteotomy through the upper end of the femur and the gradual bending of the callus about 14 days after operation. The final position, as determined before operation, was obtained with the aid of a goniometer and held with a well fitting double spica until union was complete. The results have been very gratifying and the final position obtained has varied only 2 or 3 degrees from the position as determined before operation.

Sufficient time has not elapsed to draw any conclusions from those cases of tuberculosis that were treated by extra articular arthrodesis and placed in the correct position at the time of operation. Since there is a tendency for these cases to shift into adduction and flexion, it may be desirable slightly to overcorrect them at the time of operation. In any event, it is desirable that the operator have in mind, before operation, the position which would offer the best functional result.

The following single report is sufficient to serve as an example. All X ray pictures and photographs accompanying this article were taken from this case, which was selected because a position of 17 degrees abduction was obtained, 18 degrees

being considered as the maximum that is compatible with a satisfactory gait.

Case. W. D. 146 boy aged 12 years. Patient was admitted to the Shriners Hospital for Crippled Children September 6, 1927 because of a marked flexion and adduction deformity of the left hip associated with shortening of the left lower extremity. The onset of his illness was at 4½ years of age when a limp was noticed. About a year later he began to have an elevation of temperature and complained of pain referred to the left hip. In a short time he was unable to walk. A large abscess developed and was drained. A discharging sinus remained for several months. Treatment has consisted of the application of a plaster cast which was worn about 6 months followed by a brace.

Examination disclosed an undernourished boy who walked on the toes of the left foot and who had a marked lordosis of the lumbar spine (Fig. 2). There was apparent shortening of the left leg of about 4 inches (Figs. 2 and 3). The left hip was flexed and adducted and there was passive motion of a few degrees. X rays (Fig. 7) showed that there had been a destructive process involving the left hip and that there was almost a complete absence of the head and neck of the femur. The left hip was in a position of adduction.

Clinical and X ray diagnosis. Tuberculosis of the left hip.
First operation. September 12, 1927 a Steinmann pin was drilled through the lower end of the left femur and the flexors of the hip that have their origin from the anterior superior spine were divided subcutaneously. Heavy traction was applied to the Steinmann pin for a period of 8 weeks. Starting in the line of deformity, the position of the hip was gradually changed until a position of 5 degrees abduction and 35 degrees flexion was obtained.

Second operation. November 28, 1927 the left hip was exposed through the usual Smith-Petersen incision. A small spicule of bone representing the neck of the femur was removed, the acetabulum was cleaned out and the upper end of the femur roughened. By placing the extremity in wide abduction and slight hyperextension the upper end of the femur could be placed in the acetabulum thereby

the bacteriology of wound infections, the proper study of which necessitated some knowledge of the experimental method. Safeguarded by the newly perfected operative technique, surgeons toward the end of the century found themselves, under the tacit leadership of Billroth, suddenly transformed into "internists," and the disorders of the alimentary canal became the particular object of attention. Though isolated individuals like Hunter had done so long before, surgeons as a class for the first time had begun to think in terms of function rather than of morphology, a striking contemporary example of this being furnished by the contributions to our knowledge of the disorders of the thyroid gland by Kocher and Horsley and Halsted.

Thus, broadly speaking, each generation has its investigative fashions which run more or less in the grooves of least resistance or greater promise. And just now it seems not improbable that the next twenty years will see a further concentration on the nutritional and endocrinological maladies which will necessitate a greater attention to biophysics and chemistry.

There have been of course discernible influences other than new knowledge that have had something to do with these changes of fashion. One thing that undoubtedly played a part in the withdrawal both by physicians and surgeons from active participation in pathology was the fact that at the opening of the present century this subject had become in our several schools and hospitals a highly specialized one covered by full-time and thoroughly trained appointees. In consequence, the clinician was no longer obliged and seldom encouraged to make his own autopsies, or even to study his surgical specimens upon which, indeed, the introduction of new and unfamiliar methods served to render him no longer capable of passing independent judgment. Be-

cause of this, though our opportunities to contribute to morbid anatomy are unparalleled, most surgeons have acquired a lamentable inferiority complex when brought face to face with a pathological problem.

With this preamble and its reference to the regrettable lapse, first of the surgeon's active interest in normal anatomy, and then in its turn of his waning flair for morbid anatomy and bacteriology, I wish to emphasize the opportunities for the advancement of knowledge that still lie before him in these fields, if he will put his mind to it and give the necessary time. The professional pathologist has far more to occupy his attention than he can possibly cover and is only too glad to share with his colleagues of the bedside and operating table the material that principally interests them. I speak feelingly in this matter because the basis of my address is nothing more than an old-time surgico-pathological study.

It is a study, moreover, which could not have been made had it not been for the generosity of my pathological confreres in years gone by at the Johns Hopkins Hospital and more recently at the Brigham Hospital in permitting me to control the postmortem examinations on my own patients and in allowing me to retain the tissues. Not only has this been highly profitable from the standpoint of correcting diagnostic and technical errors, but as the specimens accumulated, the collection has made possible the subsequent group-study of problems which otherwise could scarcely have been attacked. The life history of a given pathological lesion can be determined only by long experience, it does not hang solely on the impression gained by a look through the microscope. Only when taken in conjunction with the character of the operation performed and with the survival period in a long series of cases does prognosis become determined.

Slowly and laboriously the surgical treatment of brain tumors has begun to emerge from the discouragements and uncertainties of earlier days. The more dreaded of the immediate complications following intervention that so harrowed our predecessors have been largely eliminated by improvements in operative technique, more exact methods of localization have made exploratory operations far less haphazard than they once were, regions formerly regarded as hopelessly inaccessible are now unhesitatingly laid bare, tumors of sorts that a few years ago were thought to be inoperable are now attacked with a reasonable degree of confidence. What is more, the general practitioner is on the alert for these lesions so that they come under observation in stages increasingly favorable for treatment, and what is no less important, patients no longer regard an intracranial operation as one to be particularly dreaded.

All this is in marked contrast to the days some of us vividly remember when these operations were rarely undertaken except as a last resort, when cerebrospinal fistula and fungat

ing wounds were common sequels of intervention, when such simple procedures as tapping of the ventricles were looked upon as hazardous, when tuberculoma and gumma were supposed to be the more common types of tumor, and when the majority of patients were in the stage of approaching blindness, for the ophthalmoscope was not yet part of the practitioner's armamentarium.

When one contrasts those well remembered days with the present, the labor surely has not been in vain. Could one of the pioneers of intracranial surgery of the past generation see a meningioma dislodged from beneath the optic chiasm in a conscious and co-operative patient with immediately demonstrable improvement in vision, or in another, a tumor electively dissected out from the cavity of the third ventricle, he would certainly look on in amazement. And no less certainly would the neurological surgeon of today have reason for amazement could he foresee the novel procedures which those of the next generation will unquestionably come to develop, for we are only at the beginning.



RAMÓN MACÍAS
1856-1916

TABLE II—FOR ESTIMATING THE DEGREE OF LATERAL DISTORTION

| Difference in inches between real and apparent shortening | Distance between Anterior Superior Spines in Inches | | | | | | | | | | | | | | | | | | | |
|-----------------------------------------------------------------------|-----------------------------------------------------|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|--|
| | 3 | 3½ | 4 | 4½ | 5 | 5½ | 6 | 6½ | 7 | 7½ | 8 | 8½ | 9 | 9½ | 10 | 11 | 12 | 13 | 14 | |
| ¾ | 5* | 4* | 4* | 3* | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1* | 1* | 2* | |
| ¾ | 10 | 8 | 7 | 6 | 5 | 5 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 3 | 3 | 3 | 3 | 3 | 3 | |
| 1 | 14 | 12 | 11 | 10 | 8 | 8 | 7 | 7 | 7 | 7 | 7 | 7 | 7 | 6 | 6 | 6 | 6 | 6 | 6 | |
| 1 | 19 | 17 | 16 | 15 | 13 | 12 | 12 | 11 | 11 | 11 | 11 | 11 | 11 | 10 | 10 | 10 | 10 | 10 | 10 | |
| 1¼ | 25 | 21 | 20 | 19 | 17 | 16 | 15 | 15 | 14 | 14 | 14 | 14 | 14 | 13 | 13 | 13 | 13 | 13 | 13 | |
| 1½ | 30 | 25 | 24 | 23 | 21 | 20 | 19 | 18 | 18 | 17 | 17 | 17 | 17 | 16 | 16 | 16 | 16 | 16 | 16 | |
| 1¾ | 36 | 30 | 29 | 28 | 26 | 25 | 24 | 23 | 23 | 22 | 22 | 22 | 22 | 21 | 21 | 21 | 21 | 21 | 21 | |
| 2 | 42 | 35 | 34 | 33 | 31 | 30 | 29 | 28 | 28 | 27 | 27 | 27 | 27 | 26 | 26 | 26 | 26 | 26 | 26 | |
| 2¼ | | 40 | 39 | 38 | 36 | 35 | 34 | 33 | 33 | 32 | 32 | 32 | 32 | 31 | 31 | 31 | 31 | 31 | 31 | |
| 2½ | | | 39 | 38 | 37 | 36 | 35 | 34 | 34 | 33 | 33 | 33 | 33 | 32 | 32 | 32 | 32 | 32 | 32 | |
| 2¾ | | | | 42 | 41 | 40 | 39 | 38 | 38 | 37 | 37 | 37 | 37 | 36 | 36 | 36 | 36 | 36 | 36 | |
| 3 | | | | | 42 | 41 | 40 | 39 | 38 | 38 | 37 | 37 | 37 | 36 | 36 | 36 | 36 | 36 | 36 | |
| 3¼ | | | | | | 40 | 39 | 38 | 37 | 37 | 36 | 36 | 36 | 35 | 35 | 35 | 35 | 35 | 35 | |
| 3½ | | | | | | | 40 | 39 | 38 | 37 | 36 | 36 | 36 | 35 | 35 | 35 | 35 | 35 | 35 | |
| 3¾ | | | | | | | | 40 | 39 | 38 | 37 | 36 | 36 | 35 | 35 | 35 | 35 | 35 | 35 | |
| 4 | | | | | | | | | 42 | 41 | 40 | 39 | 38 | 37 | 36 | 35 | 34 | 33 | 32 | |

bringing fresh bone surfaces in direct contact and under slight pressure. The wound was closed and a double plaster spica was applied to hold the left leg in the position just described. Plaster fixation was maintained until the next operation.

Third operation. April 2, 1923 through a short incision over the lateral side of the upper end of the left femur, the femur was exposed and divided subperiosteally by a transverse osteotomy, at a point about 2 inches from the ilium. After the wound was closed, patient was placed in the bivalve plaster spica that had been worn before operation.

On the eighteenth postoperative day, this plaster was removed and both lower extremities were placed in traction. The position of the left leg was gradually changed in order to correct the extreme degree of abduction.

During this process of bending the right hip was placed in the same position as the left and the following measurements were recorded: width of pelvis between anterior superior spines 8½ inches, anterior superior spine to sole of foot, left 31½ inches, right 34½ inches. As there was a real shortening of 3 inches, it was decided to compensate for 2½ inches by abducting the hip so that there would be a remaining apparent shortening of ½ inch. By referring to Lovett's table it was found that the degree of abduction desired would be 15 degrees. When this amount of abduction and 25 degrees flexion with slight external rotation was obtained, fixation was maintained by a double spica until union was complete.

February 6, 1929. This patient returned to the clinic walking with only a slight limp and was able to assume a good sitting position (Figs. 4, 5, 6, and 8). There was no pain or discomfort in the back. The measurements were as follows: width of pelvis 8½ inches, anterior superior spine to sole of foot, right 36½, left 33½ inches, umbilicus to sole of foot, right 38, left 37½ inches. When the lumbar spine was flat a point on the leg 24 inches from the trochanter was 9 inches from the table. These measurements show a real shortening of 3 inches and an apparent shortening of ½ inch. According to the Lovett and Kingsley tables the hip was in a position of 17 degrees abduction and 2 degrees flexion which was practically the position that had previously been determined as ideal for this case. The functional result was excellent.

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EDITORIALS

SURGERY, GYNECOLOGY AND OBSTETRICS

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Chief of Editorial Staff

FEBRUARY 1931

FASHIONS IN SURGERY

[The Journal has been permitted to use in these columns the following paragraphs with which Dr. Cushing prefaced his Arthur Dean Bevin Lecture published elsewhere in this number. Eds.]

AT the meeting of the Association of Pathologists and Bacteriologists held in Cleveland in the Christmas recess of 1901, Dr. G. W. Crile and I fell into an ardent discussion one evening over the recording of blood pressure observations by means of a home made apparatus which I had shortly before seen put to use in Riva Rocci's clinic at the Ospedale de S. Matteo in Pavia. We happened to be in ear shot of Professor W. T. Councilman who exclaimed "Is this what you young men call surgery now a days?" And on our admission that it had seemingly little to do with pathological anatomy at least, he went on to say that he had just been made President of the newly reorganized Boston Medical Society, and would we come and ventilate ourselves on the matter at some scheduled meeting?

To this we consented and a year later, on January 19, 1903, to be precise, Dr. Crile dealt with changes in blood pressure during

experimental procedures while I ventured to advocate the routine plotting of the pressures during the course of operations in the clinic. It went off better than we could have expected and as an outcome of the meeting a local committee of surgeons was appointed to look into our proposals and submit them to trial. Their comprehensive Report¹ published after a year's interval ended somewhat dubiously with this sentence "The adoption of blood pressure observations in surgical operations does not at present appear to be necessary as a routine measure."

Aware that the introduction of instruments of precision into the clinic had always met with temporary opposition, this mild rebuff was not entirely unexpected, and I find written at the end of the Report, a copy of which I still preserve these lines from O. W. Holmes' "Song of the Stethoscope"

'Now such as hate newfangled toys
Began to look extremely glum
They said that *rattles* were made for boys
And vowed that his *bu zing* was all a hum'

This story has been told for the reason that it sets an approximate date when surgeons not only in this country but in other parts of the world had begun to show an awakening of interest in pathological physiology. From being primarily descriptive anatomists, surgeons with investigative tendencies during the generation let us say, of Sir James Paget, had been drawn away from the dissecting room under the attraction of what was called surgical pathology. This activity in the next generation, under the stimulus of Lister, was superseded by the overwhelming interest in

¹ Bulletin No. 1. Division of Surgery of the Medical School Harvard University. Report of Research Work, 1903-1904, pp. 1-41.

MASTER SURGEONS OF AMERICA

RAMON MACÍAS

A GREAT genius in the surgical world was Ramon Macias who was born on February 14, 1856 in the small and picturesque town of Villa de los Reyes de Salgado, Michoacan. In the same town and in the same house one of the most illustrious members of the Mexican clergy was born—Dr. Don Clemente Munguia, Archbishop of Michoacan.

Ramon Macias was the son of poor parents, Señor don Cayetano Macias and Señora doña Teodora Zepeda, who were obliged to change their residence frequently to secure the necessities of life. The boy Ramon obtained his primary education in the schools of Los Reyes and Lerma. He took a course in Latin in the Ecclesiastical school of Patzcuaro and then entered the historical college of San Nicolas de Hidalgo in Morelia to begin his preparatory and professional studies.

When he was very young he resolved to devote his life to the study of medicine because he felt that that was his true vocation. He had to overcome great difficulties in order to continue his studies in the National School of Medicine. He entered the Military Hospital as a candidate and on the completion of his course was given the rank of Major as a military physician and surgeon. He served in the army of the Occident under General Manuel Gonzalez and was then commissioned to study yellow fever in the states of Tabasco and Yucatan. At this time he was a follower of the great surgeon, Dr. Francisco Montes de Oca, whose memory is still honored as a surgeon and as organizer of the Medical Military Corps.

As a result of his brilliant work in a competitive examination Macias was made an assistant professor of clinical surgery under Dr. Rafael Lavista, a position which he held until the death of his chief, whom he succeeded, then becoming professor of surgery. Dr. Macias was especially fitted for this position because of his surgical skill and his extraordinary gift of imparting to his students his knowledge of the difficult art of surgery and of teaching them how to interpret the clinical signs and symptoms of patients.

He showed remarkable genius in making diagnoses even in the most difficult cases. For instance, before catheterization of the ureters was known and before the X-ray was of use in such cases, he diagnosed a ureteral calculus impacted at the

mouth of the ureter to the astonishment of the physicians of his time. His diagnosis was confirmed when the patient was operated on in Europe.

He invented various instruments for operations on the bladder and he was among the first to use tincture of iodine as a skin and internal disinfectant in some diseases of the circulatory and respiratory systems.

His method of performing prostatectomy deserves special mention. His technique was taught to Professor Albarran, of Paris, by one of Macías' pupils, Dr. Reynaldo Delfis. The name of Dr. Regino Gonzalez also should be credited with Dr. Macías in the working out of the technique for the prostate. Together they operated on an old prostatic with complete obstruction. They operated through a perineal incision and cannulized the bladder. During the operation it occurred to them that it might be possible to enucleate the prostate, the cause of the obstruction. This they did and the patient was cured, and lived some years free of his disease. They repeated the operation on various other patients and improved their original technique. At this time Dr. Delfis had planned a trip abroad so they took advantage of this opportunity, and had Dr. Delfis explain the operation to some of the surgeons of Europe. The operation was received with enthusiasm by Albarran and Guyon and thence became used generally throughout the world. This operation alone should preserve the name of the illustrious surgeon, if there were no other reason for it.

Dr. Macías was a man of the world with a vast general knowledge, acquired on his many voyages to Europe, where he filled the diplomatic post of assistant at the Mexican Legation in Paris, and in the United States. He had an affable disposition, was an interesting conversationalist, was always ready to do good, and was one of the most outstanding figures in scientific and social circles. He also was alderman of the Capital and president of the Council of Health.

As director of the Morelos Hospital for many years he introduced many scientific improvements and materials into this old hospital, one of the wards of which still bears his name as a homage to his memory. While operating on a patient in this hospital he acquired an infection of the index finger of the left hand which in the course of time brought about an aneurism of the aorta. When he was driving home in his carriage one day the aneurism ruptured, causing immediate death. The doctor failed to leave the carriage when his home was reached and the driver discovered that the doctor was dead. This occurred on September 19, 1916.

Death thus closed prematurely the life of this master, this man of science, this great hearted man who knew neither hate nor rancor. He was mourned by his students, his patients, and his many friends. This life of labor which had yielded so many and such excellent fruits was ended without pain or bitterness, when perhaps the mind was busy pondering over some new operation, some new method of relieving pain. Men like Dr. Macías are an honor to their name, to their country, and to humanity.

ULISES VALDES

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THE SURGEON'S LIBRARY

OLD MASTERPIECES IN SURGERY

ALFRED BROWN, M D, F A C S OMAHA

THE EBERS PAPYRUS

WHEN, in the middle of the last century, explorations in Egypt began to be carried out carefully, two famous documents, the *Papyrus Smith* and the *Papyrus Ebers*, came to light at approximately the same time. When or where the latter was found is not definitely known. It was as early as 1864 in the possession of Mr. Edwin Smith and was purchased by Mr. George Moritz Ebers in 1872 when he was in Luxor. The document consists of a roll a little over sixty six feet in length and twelve inches wide. It is made of sheets of papyrus joined together and the pages thus formed are covered with hieratic writing varying from twenty to twenty-three lines to the page or division. This writing is of a later date than the copy of the *Papyrus Smith*, and Ebers judged that the manuscript dated back to the period between 1553 and 1550 B.C. That the manuscript is a copy or rather a collection of a series of smaller old works is admitted by practically all experts in Egyptology so the exact date of its integral parts is not known.

Shortly after obtaining the papyrus Mr. Ebers set to work to unroll it and get it ready for preservation and publication. He was able to do this work so rapidly that the copy of the papyrus was soon ready to be made and in 1875 the two volumes containing the reproductions of the manuscript were published. The reproductions are preceded in the first volume by an introduction by Ebers and in the second by a Latin glossary of the hieratic terms which had been transposed into hieroglyphics by Ludwig Stern. In the introduction Ebers gives examples of the various types of hieratic characters according to their dates and in this way establishes the approximate date of the papyrus. He also gives a complete summary of the contents of the work. No attempt at a full translation was made at this time and this publication appeared under the title '*Papyrus Ebers, Das hermetische Buch ueber die Arzneimitteln der alten Aegypten in hieratische Schrift. Herausgegeben, mit Inhalts Angabe und Einleitung versehen von Georg Ebers. Mit hieroglyphisch lateinischem Glossar von Ludwig Stern. 2 Bde. Leipzig, 1875.*' It was not until 1890 that the work was translated completely and it then appeared translated into German by H. Joachim under the title '*Papyrus Ebers. Das älteste Buch ueber Heilkunde. Aus dem Aegyptischen zum ersten male vollständig uebersetzt. Berlin, 1890.*'

The title is of course faulty as it is not the "*Oldest Book concerning Healing*" but the contents of the *Smith papyrus* were known only in part in 1890 and the work had never been translated completely so Joachim's title for his book was justified.

The *Papyrus Ebers* appears to be just the reverse of the *Papyrus Smith*. In the latter there is only one case in which recourse to magic and the mystic is taken as a method of curing disease. All the other cases are studied carefully and scientifically with all reference to the supernatural left out, which would make it appear that the one case slipped in inadvertently or was added by a later author. This refers, of course, only to the body of the work and not to the material on the back of the roll. The major part of the *Papyrus Ebers*, however, appears to be a typical recipe book of the magical age of medical practice and in all approximately 973 recipes are given for use in various diseases. These constitute practically all the ways in which drugs and medicaments can be used, plasters, poultices, cataplasms, clysters, pills, drinks, boli, suppositories, and so on. Much is said of the methods of accompanying incantations, etc., with which these are to be used.

Putting all this aside there are parts of the *Papyrus Ebers* that represent a type of surgery which was being used at the time in Egypt which had nothing to do with the occult. The description as given reminds one of the style of the *Smith papyrus* and the fact that the papyrus refers to an unknown medical work as the '*Secret Book of the Physician*' it may possibly be that such was the title of the work of which the *Smith Papyrus* is a partial copy. For example "If thou findest a pus tumor in any part of a person and seest that the centre of this rises, and it is hemmed in having a rounded form, then sayest thou 'it is a pus tumor, which is present in his flesh. This will I treat with the knife,' etc." This form of placing the subject before the reader occurs many times in the truly surgical portion of the *Papyrus Ebers*. Taken in conjunction with the similarity of method of treatment of wounds advised in the two documents and the admitted fact that the *Papyrus Ebers* is a collection copied from many authors it is probable that adding the surgical matter of the Ebers document to that of the *Smith Papyrus* will give a fairly good summary of the surgical knowledge possessed by the better type of ancient Egyptian practitioner.

REVIEWS OF NEW BOOKS

THE striking feature about *Radium and Cancer*¹ by Fitzwilliams is that the author brings forth the subject of radium therapy from the standpoint of a surgeon. This is indicated in many places for example it is unnecessary to protect the clavicle in surface irradiation of breast cancer, needles are inserted into rectal cancer through the rectal mucosa, gastrostomy is recommended in cases of carcinoma of the oesophagus and the fenestration operation is recommended in certain cases of carcinoma of the larynx together with a low tracheotomy.

The fundamental principle of using small content platinum needles eliminating all beta rays over a 5 to 10 day period of exposure is brought into play in every possible instance.

Through the text are found case reports bearing upon the subject as it is dealt with in general terms. These reports add greatly to the effectiveness of the author's efforts. The illustration of applicators of application and the color representations of lesions showing the results of treatment are well made and of great value. One might especially call attention to the chapters on breast carcinoma, rectal carcinoma and uterine lesions.

The note extending all through the book is that of lack of adequate amounts of radium and proper form with sufficient elasticity for the best possible known technique. In general one obtains the impression that the use of radium in malignancy by experienced surgeons is assuming real proportions as an aid to other surgical measures and that radium therapy is in a process of evolution which may change from month to month. In short the author wishes to present his impressions gained thus far, simply as a stepping stone to further development of curietherapy as it is referred to. The list of references is rather meager and almost exclusively European.

This book should be carefully studied by every surgeon dealing with malignancy involving the structures which are discussed. A JAMES LARKIN.

THE new edition of *A Text Book for Midwives*² by Fairbairn appears 6 years after the last. It has undergone a general revision and some rearrangement of its matter without adding many pages however.

The book is well written. It contains all of the essentials a midwife should know and what is better still its directions for the management of com-

plications are safe. Any midwife who follows these instructions will not tamper with a patient so as to make it more difficult for the physician to render adequate service.

The reviewer found little to differ with the author. It is to be regretted that he did not stress watching more closely the baby's heart in normal labor.

Under breech delivery great stress is laid on the necessity for prompt delivery of the head and also on the higher fetal mortality rate yet it states that a midwife may deliver these patients without medical assistance. The Central Midwives Board now permits the midwife to attend "uncomplicated cases in primipart and multiparae alike" and it may be fairly stated that the delivery of the aftercoming head requires as much judgment and skill as anything the midwife has to do.

In spite of this criticism this is a good book.

I. L. CORNELL

THIS small book³ by Sir Robert Jones was originally written in 1915 as a war manual and has gone through three editions and many reprintings. It is a very readable and useful treatise on the more common injuries to the various joints and the adjacent bones and contains much information as to the diagnosis and prognosis together with many valuable practical and simple methods of treatment. The vast experience and unerring surgical judgment of the distinguished author are everywhere in evidence.

I. W. KIERSON

TWO volumes constitute the latest additions to the series entitled *Clinical Radiology of the Digestive Tract*⁴ and are published under the direction of Pierre Duval, J. Ch. Roux and Henri Hélière. The first volume of the series appeared 2 years ago and is already out of print. The methods of presentation followed in the first volume are continued in the present volumes. The cases have been very carefully chosen to illustrate certain points in clinical radiology. The text constitutes a running commentary of the facts which the authors consider justification of the diagnosis. Roentgenograms accompanied by explanatory outline drawings add to the value of the book. None but operative cases have been published. This valuable roentgenological atlas should be helpful to every roentgenologist and to the physician especially interested in gastrointestinal disorders.

JAMES T. CLIFF

¹ RADIUM AND CANCER (CURIETHERAPY). By DUNCAN C. L. FITZWILLIAMS. L.M.B. M.D. Ch.M. F.R.C.S. London: H. K. Lewis & Co. Ltd., New York: William Wood & Company, 1930.

² A TEXT BOOK FOR MIDWIVES. By John S. Fairbairn. M.A., B.M., B.Ch. (Oxon.) F.R.C.P. (Lon.) F.R.C.S. (Eng.). 5th ed. London and New York: Humphrey M. Hoad, Oxford University Press, 1930.

³ INJURIES TO JOINTS. By Sir Robert Jones, Bart. K.B.E., Ch.M., F.R.C.S. 3rd ed. New York and London: Oxford University Press, 1930.

⁴ RADIOLOGIE CLINIQUE DU TRACT DIGESTIF. Published under the direction of Pierre Duval, J. Ch. Roux, Henri Hélière. Deschamps, 101, rue de la Harpe, 4, Paris. By J. Cailliet, F. Moutier, P. Pouchet, F. Turis and H. J. J. Masson et Cie, 1930.

SURGERY, GYNECOLOGY AND OBSTETRICS

AN INTERNATIONAL MAGAZINE, PUBLISHED MONTHLY

VOLUME LII

MARCH, 1931

NUMBER 3

THE SURGICAL IMPORTANCE OF "BROWN FAT"

E S J KING, M D, F R C S, MELBOURNE, AUSTRALIA

Stewart Lecturer in Pathology University of Melbourne

AN investigation into our knowledge of the mode of formation of fat tissue, its alterations and reactions in disease reveals many hiatuses

From the time of the application of microscopy to the study of tissues, there have been two views of the origin of fat (1) that the fat cells develop from special cells the function of which is to develop and store fat, and (2) that the fat is stored by cells which are constituents of, and ubiquitous in, the connective tissues

Around this question, a constant dispute has been waged and evidence in support of both views has been submitted

Todd and Bowman, Toldt, Ranvier, Bohritzky, and Klein supported the view concerning special fat cells, while Kolliker, Czajewicz, Flemming, and the Hoggans considered that they arose by a modification of connective tissue cells. The question is still undecided, but the evidence is in favor of the former view

Toward the end of the last century, Ehrmann, Paljakoff, and Metzner described large spheroidal cells containing small globules of fat instead of the single large globule. These cells had been named by Ludwig, "mulberry cells"

In 1902, Batty Shaw reviewed the position and examined material obtained from the human fetus and newborn. He found that the fat in the subcutaneous tissue of the

human embryo occurred in cells containing a single globule. On the other hand, the fat in the axilla and beneath the pleura did not contain the signet ring cells of ordinary fat, but possessed cells showing abundant protoplasm containing small fat droplets and a central nucleus¹

In the same year, Hatai described, in human embryos, the presence of an interscapular gland corresponding to the so-called hibernating gland of the lower animals. This consisted of a narrow paired organ lying in the neck and extending into the scapular region. This hibernating gland in the hedgehog had been well described in 1893 by Carlier

It thus appeared that in the human being there were two forms of fat, the ordinary yellow fat and another variety which was present only in the fetus and young children

In 1908, however, Bonnot investigated the question very thoroughly and found that this less common tissue extended over a much larger area than that stated by Hatai. He also found that it did not disappear entirely after childhood, but could be found in the adult. Resulting from this description, the tissue is sometimes called the gland of Bonnot. It is well developed in the newborn and in adults it is a lobulated structure, pinkish in color and, on section, having the appearance of gland tissue. In the cadaver the color is

¹He considered however that this was merely a stage in the formation of ordinary fat.



Fig 1



Fig 2

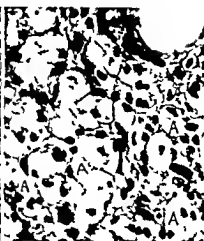


Fig 3

Fig 1 Photomicrograph of a section showing the type of tissue found in the specimen removed in Case 1. There are a large number of moruloid fat cells and a very few fat spaces $\times 35$

Fig 2 Higher power view of the tissue shown in Figure 1. A giant cell is present near the fat space, but the typical

cells are those comprising the remainder of the section $\times 135$

Fig 3 High power showing the characters of the cells shown in Figures 1 and 2. The cells have central nuclei and in the protoplasm there are numerous fat droplets $\times 600$

dark brown. Its distribution is irregular and it may be found in the neck, axilla, breast, and in the subpleural and perirenal tissues.

Bonnot concluded that the "gland" was constant in mammals, corresponded to the hibernating gland of the rodents, and that its probable functions were the storage of fat, as a scavenger of fat and as a blood forming organ. The evidence for the last suggestions is given in his paper. Suffice it to say that the size of the gland varies with the state of nourishment of the individual, that the gland differentiates during development, into hemolymph glands which are known to produce blood corpuscles and that the cells of the gland, at times, are observed to contain blood pigment.

This fat tissue has been designated brown fat from its color, mulberry or moruloid fat from its microscopic appearance, and the interscapular gland, from its position in animals.

In 1909, Shattock read a paper before the pathological section of the Royal Society of Medicine on "Normal Tumour-like Formation of Fat." He reaffirmed the distinction between the two types of fat and showed that the fatty masses occurring in the necks of cretins were composed of brown fat.

In 1927, Inglis described tumors arising in the brown fat or "interscapular gland" of the neck of infants, and he mentioned one other case recorded previously.

Apart from these descriptions of pathological changes in brown fat, the possibility that disease of this structure might give rise to disturbances of surgical importance has been overlooked.

Having encountered, in various parts of the body, nodules which microscopically present the appearances of brown fat, and particularly since similar lesions have not been recognized—or at least not reported in the literature—3 cases are described and discussed.

CASE HISTORIES

CASE 1 B. M., male, aged 40 years, proprietor of a knitting factory. He complained of a lump in the right groin of at least 3 months' duration. He thought it came on suddenly. It was tender on palpation, and movement of the right leg caused pain. There was no pain while he rested. There had been no gastrointestinal disturbance and he had not lost weight. He had had an operation for a right inguinal hernia, 2 years previous to the present illness.

Examination disclosed a hard, irregular mass in the right iliac fossa. It appeared to be under the skin and had indefinite edges. It could also be felt on the right side of the pelvis on rectal examination. A clisma revealed a normal colon. A piece of tissue

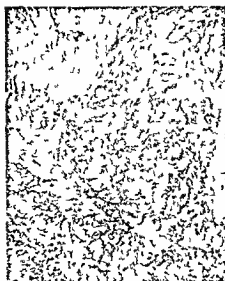


Fig 4

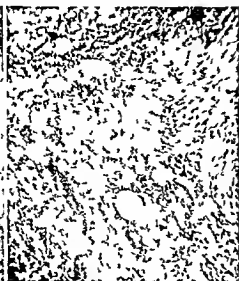


Fig 5



Fig 6

Fig 4 Photomicrograph of a section of the tissue removed from Case 2. The moruloid cells in alveolar formation are seen. $\times 40$

Fig 5 Another view of the same tissue as is shown in Figure 4. $\times 75$

Fig 6 High power view of the cells of the tissue shown in Figure 4. The resemblance of this tissue to that shown in Figure 3 and also to the inflamed brown fat removed from the guinea pig (Fig 16) will be seen. $\times 676$

was removed for microscopic examination. The tissue was very hard and grayish white in color.

The evening temperature was raised (99 to 100 degrees) for about a month, when it subsided. The mass also disappeared. Several months later patient appeared to be quite well, with no mass or abnormality of the right iliac fossa.

Pathological examination. The tissue was an irregular piece measuring $\frac{1}{2}$ inch in diameter. It was grayish brown in color and extremely hard. Microscopically it consisted of collections of cells containing a considerable amount of protoplasm in which there were numerous fat droplets. The nuclei were centrally situated. These cells were arranged in fairly definite alveoli, some larger than others. Between the cells there were small round cells, fibroblasts, endothelial cells, and a few giant cells (Fig 2). At the periphery of the nodule there was ordinary fat tissue which was inflamed, but the transition from this tissue to that of the nodule was abrupt. Under high power, the cells were seen to contain globules of varying size (Fig 3), the majority small but some almost filling the cell and pushing the nucleus, which is in most cases placed centrally, to the periphery.

CASE 2. Mrs. L., aged 38 years, complained of a tender lump in the lower portion of the abdomen of 3 weeks' duration. She was supposed to have spat out a hydatid of the lung years before, but otherwise her past history was negative. Three weeks before coming for treatment, she noticed a soreness in the lower part of the abdomen. A week later she noticed a lump and this gradually became more sore.

Examination disclosed a tender rounded mass deep in the abdominal wall about 2 inches in diameter and extending to about 2 inches from the pubes. It was decided to investigate the condition.

At operation, a mass about $1\frac{1}{2}$ inches in diameter, arising from the extraperitoneal fat, was removed. The patient made an uninterrupted recovery.

Pathological examination. Macroscopically, the tissue was irregularly rounded in shape, brownish yellow in color (after having been in formalin), and of moderately hard consistence. Microscopically, it consisted of small lobules of tissue some of which were almost identical with the lobules of fat in brown fat. The cells contained centrally situated nuclei and the protoplasm was filled with numerous small globules of fat. There were a few typical fat spaces. This appearance was found at only one portion of the tissue. In most sections the same underlying arrangement of tissues could be seen, but both the alveoli of the "moruloid" fat cells and the intervening fibrous connective tissue were infiltrated with the cells of inflammation—small round cells, endothelial cells, fibroblasts, etc. (Figs 4, 5, 6).

CASE 3. A. L., female, aged 18 years. The patient had been suffering from a pyrexia of unknown origin for 7 weeks, undergoing medical treatment. She then developed a nodule in her left supraclavicular region. The writer saw the patient for the investigation of this condition. The nodule was removed in the hope that it might throw some light on the general condition. Subsequently the patient recovered without a diagnosis having been arrived at.

Pathological examination. The portion of tissue was $\frac{1}{2}$ inch by $\frac{1}{4}$ inch in diameter and partly dark yellow and partly reddish in color. It was gland like in consistence. Microscopically, the tissue consisted of lobules of "moruloid" cells in a connective tissue stroma. The cells showed the characteristic appearances. In one portion of the section, corresponding to the reddish area seen macroscopically, the structure was that of a haemolymp gland.



Fig 7

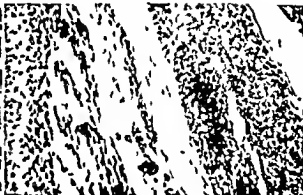


Fig 8



Fig 9



Fig 10

Fig 7 Photomicrograph of a section taken from the neck of a fetus 120 millimeters crown rump length. The rectangle shows the area of Figure 8 $\times 35$

Fig 8 Photomicrograph of the area shown in Figure 7 $\times 145$

Fig 9 Photomicrograph of a section taken from the fat removed from a guinea pig 10 days after traumatization. The rectangle indicates the area of Figure 10 $\times 145$

Fig 10 Section showing phagocytic cells between fat spaces $\times 635$

Other examples, observed by the writer, which possess special features will be described elsewhere

The suggestion that some of the less typical portions of the lesions were examples also of inflammation in brown fat led the writer to investigate the result of inflammatory changes in this tissue in lower animals

EXPERIMENTAL INVESTIGATIONS

Experiments were performed on guinea pigs (*cavia porcellus*). These animals were chosen since they are handled easily in the laboratory and because the interscapular gland is well developed in rodents

It was found that the fatty mass between the scapulae was, in some cases, composed of

yellow fat, but that in adult males, the fat was often of the brown variety. In some cases both forms were present, though they were fairly definitely demarcated from each other

Under aseptic conditions, the skin was incised and the fat traumatized by crushing. The fat tissue was removed subsequently and examined microscopically. The result was an inflammatory reaction (Figs 9, 10, 11, 12, 13)

In the yellow fat, the inflammatory cells appeared between the fat spaces, while in the case of the brown fat, the characteristic groups of "moruloid" cells (Fig 14) also contained small round cells, endothelial cells, fibroblasts (Fig 15), and a few polymorphonuclear leucocytes



Fig 11

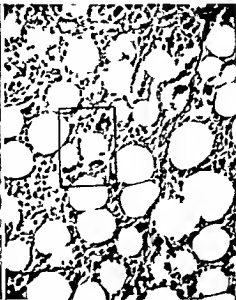


Fig 12



Fig 13

Fig 11 Portion of a section of yellow fat, 24 days after aseptic trauma. Numerous phagocytic cells are present in the neighborhood of the fat spaces. $\times 135$

Fig 12 Portion of a section of yellow fat, 6 days after

aseptic trauma. The rectangle indicates the area of Figure 13. $\times 135$

Fig 13 Phagocytic cells and giant cells are shown in relationship to fat spaces. $\times 600$

It is apparent from a perusal of the sections that the lesions induced in the brown fat of the guinea pig were similar to those found in the lesion described in the human cases, and the tissues in these, therefore, were considered to be inflamed brown fat.

DISCUSSION

In the 3 cases described, a nodule developed which microscopically showed a picture which suggested brown fat. In one of the cases (Case 3), the position is such as would be expected for the occurrence of such a lesion. Brown fat, in this site, is a well recognized anatomical and pathological entity. The occurrence of the hemolymphglandular structure is also confirmatory in consideration of the work done by Bonnot.

In the second case, the presence of typical brown fat is of importance, since it establishes another hitherto undescribed site for the occurrence of this form of tissue—the posterior aspect of the anterior abdominal wall.

Lest some error of interpretation had been made, or the association of this tissue with the main part of the nodules were accidental, the experiments described above were performed. The picture produced in the experimental conditions was extremely like that

observed in the specimens taken from human beings (compare Fig 16 with Figs 3 and 6).

It will be seen that the resemblance was both macroscopic and microscopic. On gross examination, the nodules were not the ordinary yellow color of fat tissue, but became brownish on preservation in formalin (in one case, Case 1, this color was obscured partially by the inflammation). On microscopic examination, under the low power, the tissue is seen to consist of lobules of tissue which contain cells, in closely packed formation, possessing vacuolated protoplasm and central nuclei. The tissue is more cellular than ordinary brown fat, but closer inspection shows this to be due to the presence of the cells of inflammation.

It was these observations that suggested that the conditions were due to the occurrence of inflammation in this brown or moruloid fat.

From this conclusion, important questions arise. For example, what is the relationship of these moruloid cells to those present in the cases of inflammation or fat necrosis occurring in ordinary yellow fat?

These cells have been described as fetal (Keynes), but this appears to be a misinterpretation, since Shaw has shown that the fat cells of the fetus are of the typical variety

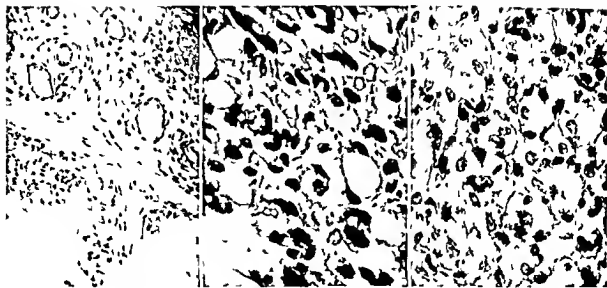


Fig. 15

Fig. 16

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12 days after aseptic
the characteristic cells in

view of the cells in the tissue
nical arrange

ment of the fat globules and have central nuclei. There
are a number of cells of inflammation between them. X600

Fig. 16. Another portion of inflamed brown fat tissue
taken from a guinea pig 10 days after aseptic trauma.
The resemblance to the lesions in the human being is
shown by a comparison with Figures 3 and 6. X600

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were ordinary fat cells surrounded
excess of inflammatory phag
cells did not appear a satisfactory
necrosis. Lastly, an examination of the
cells in cases of inflammation in fat shows

that they are wandering cells which are pres
ent in addition to the ordinary cells of the
part. In the case of the specimens described,
however, the cells appeared to be actually
forming the tissue and other inflammatory
cells could be found among them.

An interesting case was described by Fab
van. A child after birth was found to have
a number of areas of fat necrosis in the sub
cutaneous tissues of various parts of the body.
Fabry described cells containing a large
number of fat globules. These may have
been phagocytic cells, but it is possible that
this may have been an example of extensive
distribution of brown fat. A difference in the
type of fat is one of the simpler explanations
for the sporadic occurrence of this necrosis.
This is pure hypothesis, but the writer hopes
to produce evidence in favor of this view later.

It has been suggested to me that the tissue
in the cases described may arise by a reversion
of the fat cells to this brown type. There are,
however, several objections to this opinion.
In the first place, this reversion has no proto
type in embryology or physiology—the two
forms of tissue are quite distinct. At this

stage of investigations, it is not possible to give any personal statement concerning the relationships of yellow and brown fat. Hence, though further investigation may modify the view, the evidence of other writers showing that they are distinct throughout the whole of their life history is accepted. Secondly, it seems improbable that pathological change would mimic, so closely, the normal structures as to give the appearances seen in some of the tissues examined. Then the moruloid cells are in remarkable excess of the very few fat cells present. One would not expect such a complete transformation throughout the whole of the tissue and lastly the change from this brown fat to the ordinary yellow fat in the neighborhood was abrupt. There were no gradations from one to the other.

From a consideration of these various arguments, together with the conclusions derived from the experimental work, the suggestion that the lesions are inflammation occurring in brown fat is considered to be on a firm basis.

Diseases occurring in brown fat have seldom been reported. The occurrence of neoplasms has been referred to, but inflammation in this tissue has not been recorded previously.

Since brown fat apparently has an inconstant distribution, it is not surprising that examples of disease should be of sporadic occurrence. At the same time its distribution is widespread, so that such disease may be found almost anywhere in the body (the exact distribution will be determined only by future research), but especially in the neck and retroperitoneal tissues and other well recognized sites of this peculiar fat tissue.

It will be seen that inflammation in this tissue may give rise to a definite, more or less localized, swelling, for example, in the abdominal wall, and a knowledge of this condition, both macroscopic and microscopic, is essential for proper diagnosis and treatment.

Attention is called to the lesions described, so that further observations may help to elucidate both the physiology and pathology of so called brown fat tissue.

SUMMARY

1 The occurrence, distribution, embryology, and physiology of brown fat is discussed.

2 Its occurrence in the posterior aspect of the interior abdominal wall and in the retroperitoneal tissue in the iliac region is described.

3 Three examples of inflammation in this tissue are described and discussed.

4 The relationship to other lesions is discussed.

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INFECTIVE GRANULOMA

NON SPECIFIC CHRONIC TUMOR LIKE PROOUCTIVE INFLAMMATIONS OF THE GASTRO-INTESTINAL TRACT¹

HARRY E. MOCK, M.D., F.A.C.S. CHICAGO

Associate Professor of Surgery Northwestern University Medical School

I HAVE chosen to use this term of "infective granuloma" as it recalls to many clinicians a definite though non specific disease entity. To some pathologists the term is a misnomer and should not be used. E. D. LeCount and Edwin F. Hirsch of the pathological department of St. Luke's Hospital, for example, designate these conditions as chronic productive inflammation or inflammatory hyperplasia and claim that the suffix "oma" refers to a true tumor.

Because of this objection I sought the views of six other leading pathologists and of several surgeons concerning the correctness or desirability of this title. James Ewing suggested a portion of the subtitle and stated further in his letter "The term 'granuloma' does not signify tumor. It is applied to tuberculosis, syphilis, leprosy, Hodgkin's disease, and other infectious processes which produce local overgrowths resembling a tumor. The ending 'oma' strictly speaking does signify a tumor, but usage overrides all these considerations and justifies the use of the term as you propose."

W. F. Peterson, of the University of Illinois, replied that he could see no particular objection to use of the term granuloma because the term does not necessarily indicate a malignant affair but merely an overgrowth of tissue which may be either inflammatory or neoplastic. He suggested that the term "infectious granuloma" would be better.

Clinicians for so many years have used the title "infective granuloma" that it does not seem justifiable to change it unless some real objection can be found to the word "infective." Dorland defines "infectious" as "Incapable to be communicated by infection. An infectious disease is one caused by parasites, such as bacteria, protozoa, or fungi, and it may or may not be contagious." He defines "infective" thusly "Of the nature of an in-

fection, infectious." Since we are trying to define the nature of these granulomas rather than suggest, even remotely, the communicability of the infection, I believe the old title of "infective granuloma" should stand.

J. P. Simonds, of Northwestern University Medical School, in his letter gives the views of several other pathologists as follows: "I have your letter concerning the use of the term infective granuloma. This term, like many others in medical nomenclature, is recognized by pathologists to be faulty in many respects but it has in its favor long usage. In the minds of those who use the term it generally has quite a definite connotation. Karsner, Stengel and Fox, Beattie and Dickson, and Oertel use either infectious granuloma or infective granuloma. MacCallum and Mallory do not use the term at all. Delafield and Prudden do not employ the term and in a footnote criticize its use. They state 'It may be doubted whether it is wise to group together, under a name suggesting tumor relationships which do not exist, lesions of such diverse origin and clearly of infectious character.' Aschoff in his *Pathologische Anatomie* instead uses 'spezifische Entzündungen (infektiöse Granulationsbildungen)'. Ribbert in his *Lehrbuch der allgemeinen Pathologie* classes this condition under 'Die proliferativen Entzündungen'."

"The term 'infective granuloma' therefore has usage in its favor but is open to very definite criticism. No satisfactory term has, however, been offered to take its place."

H. Gideon Wells strongly supports the clinicians' viewpoint. He says "I can see no objection to the use of the term 'infective granuloma' for such conditions as you describe. Certainly usage does not justify the statement that 'oma' always refers to true tumor. It simply means a swelling, and the use of tuberculosis, syphiloma, etc., is uni-

¹From the Surgical Clinic St. Luke's Hospital, Chicago, and Department of Surgery Northwestern University Medical School.

versal We announce annually in the University of Chicago catalog a course on the 'Specific granulomata' 'Usage makes language' and the term granuloma has certainly a long enough historical background to justify its use In this matter Doctor Esmond Long, who is our best authority on both history and etymology, agrees with me"

Finally, A S Warthin sums up the whole situation exceedingly well in his letter, as follows "Replying to your letter of March 29, I do not see why you should not use the term 'infective granuloma' if you are sure that these masses of granulation tissue are due to chronic infection Any large mass of granulation tissue, large enough to be regarded as tumor-like and due to any chronic infection, syphilis, tuberculosis, blastomycosis, etc., can be included under the general term of infective granulomata The pathologists who contend that the suffix 'oma' always refers to true tumor usually overlook the fact that chronic infective granulomata represent a special class distinct from tumors, having been separated from tumors as soon as their etiology became known, and that we use this term constantly in speaking of tuberculosis, syphilis, actinomycosis, granuloma pyogenicum, condylomata, etc The only objection I can see in its use for your paper is that some specific chronic infection is usually indicated As long as you do not know the etiology but are sure they are infective granulomata I would suggest the title 'Infective Granulomata of the Gastro-Intestinal Tract of Unknown Etiology'"

The surgeons consulted all seemed to agree that the term "infective granuloma" has had wide usage in the medical literature, that it conveyed the idea to them of an inflammatory tumor-like mass, invading some tissue or viscus whereas inflammatory hyperplasia indicated nothing but a hyperplasia of granulation tissue They feel that the suffix "oma" has been used for so long a time in connection with tuberculosis, syphilis, and the other specific infections as to warrant its use in connection with these non-specific infections

Considering the importance of this condition, especially in the differential diagnosis of obscure tumors of the abdomen, it is surpris-

ing how inadequately the medical literature of our own country has dealt with these inflammatory granulomatous masses as a definite entity It has been mentioned and described time and again in articles dealing with chronic ulcers of the stomach and intestines, in chronic adhesive peritonitis, in certain types of diverticula, in omental hyperplasias, and in inflammatory masses developing about sutures in herniotomies Others have described the condition under colitis and pericolitis following ulcers, polypi of the intestine, foreign bodies within the intestine, and infarction of the mesentery In most of these articles the preliminary condition is stressed and the resulting inflammatory mass, often of such size as to give all the signs and symptoms of a tumor of the abdomen, receives secondary consideration

One of the first clinical reports of these non-specific inflammatory tumors of the intestine, dealing with the subject as a definite entity, was made by Braun in 1909 Prior to then these cases were usually regarded as instances of "hyperplastic tuberculosis of the intestine"

In 1909, Le Dentu described similar cases under the heading "False Cancers and Inflammatory Tumors in the Abdomen" He subdivides these into four groups (1) interstitial colitis, circumscribed in character, and associated with hypertrophy, resulting in a certain amount of stenosis, (2) simple pericolitis with adhesions, (3) diffuse pericolitis with the formation of an elongated mass, (4) exuberant pericolitis, in which form the intestine and extraperitoneal connective tissue and glands are all matted together

In 1923, Eli Moschowitz and A O Wilensky, under the title of "Non-Specific Granulomata of the Intestine" gave a clinical and pathological study of four cases with five specimens carefully examined These authors emphasized the following facts (a) its recognition thus far seems confined to European observers, (b) its literature covers only the last decade, (c) its interest is not entirely morphological but it is important from the standpoint of clinician and surgeon alike as it must be considered in dealing with obscure tumors of the abdomen

In 3 of their reported cases the cæcum and ascending colon and in the fourth the splenic flexure of the colon were involved. In 2 cases the appendix had been removed for a suppurative appendicitis, and in the third case a chronic appendicitis was found in the mass removed by resection of the cæcum and ascending colon. In all 3 specimens a firm, tense, unencircled tumor was found involving all the coats of the intestine, causing stricture of the lumen. In 3 cases there was superficial ulceration not involving the mucosa. In one specimen the main bulk of the tumor projected into the mesentery. In the fifth specimen a granuloma of the small intestine developed a year later, after resection of the ascending colon for a granuloma, almost a foot of the small bowel was involved in an unencircled mass which encroached upon the lumen until it was almost obliterated.

Microscopically, these cases gave almost identical findings viz. interstitial infiltration of all the coats of the intestine with round cell or plasma cell type. They showed a wide variation of a fibroblastic transformation from a comparatively richly cellular tissue, to a firm, tense fibrous scar. New blood vessel formation was prominent in all specimens. In two specimens the presence of giant cells were noted, especially prevalent in the specimen from the small intestine. In 2 of their cases bacterial stains were made for tuberculosis bacilli and none was found. In none was there evidence of caseation. The Wassermann was negative in all cases.

DEFINITION

Infective granulomata are tumor like masses influenced to a certain extent by a low grade, non specific infection and characterized by a piling up of granulation tissue showing varying stages of necrosis, fibroblastic changes, and true scar tissue or reparative tissue growth. These masses, usually more or less non encircled, often reach the size of an orange, a grapefruit, or occasionally a child's head. They do not include those specific infections the chief characteristic of which is the formation of tumor-like masses, often called specific granulomata such as the gumma of syphilis and the hyperplasias of tuberculosis, actino-

mycosis, blastomycosis and anthrax. In this article the discussion is limited to those non specific inflammatory masses occurring in the gastro intestinal tract although similar tumor like conditions occur in other parts of the body, notably in certain bone conditions, in infections of glands, and in other locations surrounding foreign bodies or even about hematomata.

PATHOLOGY

These inflammatory granulomata or hyperplasias are usually sterile. The underlying cause of their formation is some local interference of the blood supply to the given tissue, followed by a small area of necrosis, followed by a reparative tissue reaction. The necrosing process may continue to progress slowly with a corresponding increase in the reparative process—round cell infiltration, fibroblasts, connective tissue stroma and new blood vessel formation—until a definite granulation tumor like mass has formed.

In the beginning low grade infective organisms, usually staphylococci or bacillus coli, may be present and may cause a local tissue reaction which, due to round cell infiltration and fibrosis, may in itself so interfere with the circulation as to result in the slow piling up of the chronic granulation tissue. Or such an inflammatory mass may later in its course become invaded by pyogenic organisms even to the point of abscess formation. But as a rule these granulomatous masses soon become or remain sterile.

The inflammatory hyperplastic masses correspond to the infective granulomata first described in this country by Senn. He described a granulomatous tumor the result of a necrosis of tissue, usually due to some mechanical constriction of blood supply to the involved tissue followed by a low grade infection, followed by a reparative process. The necrosis, low grade infection, and reparative process go hand in hand occurring simultaneously, but the reparative process predominates, resulting in a piling up of granulation tissue until a tumor like mass is formed. In other words, we have a breaking down and a building up with the latter conquering.

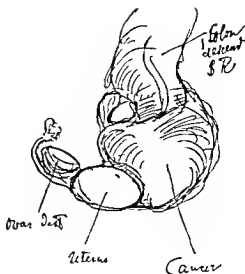
Without question, inflammatory adhesions, thickenings of the omentum such as are found

in the neighborhood of infections, or when constricted in a hernial sac, fibrosis about the site of an ulcer, and these larger masses of inflammatory hyperplasias are all of similar causation and developmental process. The latter differs in the degree of momentum and period of activity, the piling up of granulation or reparative tissue continuing as long as the infective or necrotic process remains unconquered. Thus, if no dire result occurs, such as an obstruction of the bowels, the granuloma may grow to the size of an orange or a grapefruit, may become irregular in shape, may include adjacent tissues in its mass, and may possess areas of softening or ulceration and other areas of indurated firmness, and withal may so resemble a malignant tumor that it can deceive the keenest observer. Neighboring glands are frequently enlarged thus adding to the deception. And if at operation a small piece of the tumor is removed and given to the pathologist for frozen section and immediate report, the surgeon may be even further confused. In two of the cases hereinafter reported the frozen section report in one was carcinoma and in the other, small round cell sarcoma. It was only after repeated studies of more carefully prepared sections that the true diagnosis was established, and was verified by the subsequent course of the two cases.

Microscopically, such a granuloma reveals a mass of chronic granulation tissue in which the chief elements are mononuclear cells and lymphoid cells. Other areas are densely infiltrated with polymorphonuclear leucocytes. The picture may vary from fibroblastic and lymphoid tissue surrounding areas of necrosis to well defined connective tissue stroma with developing blood vessels, depending upon the age of the hyperplasias. Occasionally, large mast cells resembling giant cells are seen. An area containing these mast cells and large groups of lymphoid cells can easily be mistaken for carcinoma while the small round cells may so predominate the picture as to make it resemble sarcoma.

ETIOLOGY

The etiological factors which predispose to infective granulomata formation are



*Granulomatoses Carcinom
des linken Ovar und des
Sigmoides, mit dem
Krebskeim fast ununterschiedlich
und trotz der Mikroskopie
nicht von der Krebskeim
her zu unterscheiden*

Fig. 1. Drawing submitted by Professor Bumm, describing a "cancer" in left ovary and sigmoid which was unquestionably an infective granuloma (see Case 1).

1. Conditions existing within the gastrointestinal tract itself or its mesentery,
2. Extrapentoneal infections which gradually spread to and involve the gastrointestinal tract,
3. Trauma (a) surgical trauma or accidents, (b) extraneous injuries.

My cases include examples of all three of these groups but by far the commonest cause was trauma.

1. Conditions existing in the gastrointestinal tract itself. Certain types of sigmoid diverticulitis furnish the best examples of the condition. The diverticulum with a small opening on the mucosa but with a balloon-like protrusion on the peritoneal surface, often contains a small amount of hard, inspissated feces. Erosion, low grade infection, necrosis, round cell infiltration of the adjacent mesentery, with this reaction extending upon and around the adjacent bowel, linking or constricting the bowel, and all of this accompanied by the peritoneal and omental tissue reaction to inflammation soon gives a granulomatous mass about this diverticulum that is almost



Fig 2 Infective granuloma of stomach thought on gross examination to be carcinoma. No previous ulcer history (See Case 3)



Fig 3 High power field of infective granuloma of stomach which is seen in Figure 2. Patient has remained well since operation.

impossible grossly to distinguish from a malignant tumor. Such a condition may develop in and about diverticula anywhere in the intestinal tract. Author's Case 1 is the best example of this condition (Fig 1).

A preliminary paper was given 3 years ago before the Pennsylvania Railroad Surgeons Association. In the discussion, one of the surgeons told of the case of his brother. Five years previously he was operated upon for a tumor of the sigmoid. This tumor was diagnosed as carcinoma and was considered inoperable. A colostomy was done. This patient 5 years later was in good health, the evidence of malignancy had disappeared, but the colostomy still functioned. Efforts were made to persuade this brother to submit to examination with the possibility of closing the colostomy, but he refused. In all probability this was an infective granuloma and not a malignancy.

Typical of quite a number of unreported cases which I have collected from different surgeons is the following:

Dr M H Cremer of Red Wing, Minnesota writes concerning patient F H farmer, aged 62 years. His chief complaint was of stomach trouble of 2 months duration. During the past 2 weeks he has had distressing pain in the abdomen not associated with eating and bowels had been constipated. The examination including X ray examination was negative except for a small inguinal hernia and a small epiplocele just above umbilicus, stomach analysis negative. He was placed on medical treatment. Three weeks later patient returned for exploratory operation. No pathological change was found in stomach or intestines. The hernia were repaired. Patient grew gradually worse and on February 23, 3 months later a barium meal revealed an intestinal obstruction. Patient was re-operated upon on February 27. A granulomatous mass with a tight constriction of the colon at the sigmoid flexure was found. The bowel above was distended, below, collapsed. A four inch resection was made. The microscopic examination showed "inflammatory plastic tissue—no malignancy." The follow up report shows that patient gained 30 pounds and was quite well one year later.

Braun in his article, reports a case of a woman aged 43 years who had a tumor the size of an orange in the left abdominal cavity of 8 weeks duration. A diagnosis of carcinoma was made. At operation a mass in the sigmoid flexure involving chiefly the

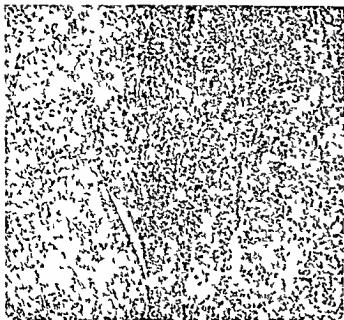


Fig 4 Photomicrograph of infective granuloma described in Case 6



Fig 5 Photomicrograph of infective granuloma described in Case 7

mesentery aspect was found. On removal it was found to be fatty tissue with connective tissue infiltration but no signs of malignancy. He presented this as an example of a granuloma around a diverticulum.

Neupert reports a tumor case diagnosed at operation as inoperable carcinoma in which there was perforation of one or more diverticula into the mesosigmoid. He describes the tumor as made up of connective tissue formation and cicatricial contraction of the mesentery.

Monsarat reports a case of a man aged 44 years who had suffered abdominal pain, vomiting, and distention for 6 months with an obstruction for 8 days. Examination revealed a firm, tender, and movable mass in the left lower quadrant. A granulomatous mass about the size of an orange was removed at operation from the sigmoid loop. Microscopic examination showed the tumor to be due to a mass of cicatrix and inflammatory infiltration—a perisigmoiditis with considerable exudate. Monsarat reports a second case of a man of 47 years who had constipation for one year and later blood in the stools. Examination revealed a mass in the left lower quadrant. Diagnosis of malignancy was made. At operation the mass proved to be a granulomatous tumor.

The inflammatory hyperplastic mass developing at the site of a gastric ulcer, usually following a small perforation, is another well known example. It is a known fact that these are frequently mistaken for cancer. The differential diagnosis is rendered more difficult because of the enlarged glands. Ulcers exist-

ing anywhere in the intestinal tract may act similarly (author's Cases 2, 3, and 4—Figs 2 and 3).

Dr Edward Doepp, of Blue Island, Illinois, and Dr George Scupham, of Homewood, Illinois, recently told me of performing several years ago an abdominal operation for tumor. They found a large tumor of the greater curvature of the stomach. It was quite characteristic of malignancy and was, in their judgment, inoperable. The abdomen was closed and the family told of the presence of cancer. This patient is still alive and in good health. Many a surgeon, with a sense of chagrin, can report similar cases.

Polypi of the intestine may undergo necrotic changes followed by reparative inflammatory reactions and may develop tumor-like masses sufficiently large as to cause intestinal obstruction. These polypi are frequently mistaken for carcinomata.

Foreign bodies within the intestines and even hard, inspissated feces in old people may likewise start this inflammatory reaction, resulting in a tumor-like formation.

Jaffee and Monan both describe simple granulomata forming in the intestines about portions of bone. Others have described inflammatory thickenings with adhesions about foreign bodies in the intestine. Many remem-

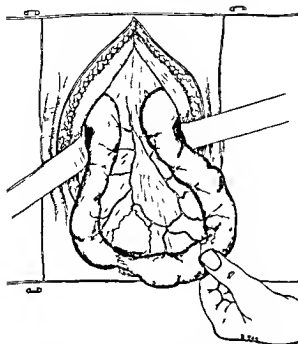


Fig. 6 Drawing of constricting infective granuloma of small intestine the result of a traumatic tear in the mesentery

ber Senn's famous case of the man who ate fruit cake 9 months previously and at operation this cake formed the nucleus of a "granuloma"

Hyperplastic colitis, a form of pyogenic colitis, is a condition described by Alexis McGlannon in Lewis' *Surgery*. It follows invasion of all the coats of the bowel by pyogenic organisms

"The hyperplastic form represents a vigorous reaction to the invading organisms, which shows itself in the production of a circumscribed mass of inflammatory tissue. The cæcum and ascending colon are the segments usually involved. The bowel wall is thickened by infiltration with inflammatory products and the lumen is narrowed by the swelling. Necrotic areas with leucocytic infiltrations and giant cells are found scattered through the inflammatory mass. The mucosa may be but is not always ulcerated. The mesenteric glands are enlarged, and there are adhesions about the mass."

Such a condition as this author here describes may develop in the intestinal wall at the site of a solitary ulcer, as the result of an infected appendix or diverticulum or of an infected mesenteric lymph gland, it may be

caused by a mesenteric infarction resulting in a localized necrosis of the bowel or from a foreign body wound of the intestine—a penetrating wound from without or one from within the gut itself. The resulting condition is a typical granuloma. At times, however, the cause of this hyperplastic colitis or granuloma cannot be ascertained.

Moynihan reports the case of a man aged 62 years with intestinal trouble of 3 months' standing and with acute obstruction

A tumor mass in the left upper quadrant could be felt. A diagnosis of carcinoma was made. On operation a tumor the size of a coconut was found in the transverse colon. The transverse colon was red, thickened and distended while the descending colon was pale and empty. Anastomosis was made between the sigmoid flexure and the distal end of the ileum as removal of the mass was impossible. Patient made a complete recovery and in a short time there was complete disappearance of the tumor.

A partial volvulus or partial obstruction from bands of adhesions may set up a low grade pericolic inflammation which does not cause such marked reaction in the gut itself but which causes a hyperplastic reaction in the adjacent omentum until it is so thickened and enlarged that it resembles a good sized tumor (author's Case 5).

Proust reports the case of a woman aged 32 years who had a progressive tumor. Some time previously she had had a laparotomy performed. At operation the tumor was found to consist of adherent thickened omentum, the lumen of the colon being constricted by a projecting spur of the mass. Microscopically it showed inflammatory thickening and sclerosis but no malignancy.

Finally, constriction of the bowel and omentum in hernial sacs, both external and internal hernie, may result in an inflammatory hyperplasia until the whole is matted together in a tumor like mass.

2 *Extraperitoneal infections which may gradually spread to and involve the gastro intestinal tract.* A low grade infection in the retroperitoneal lymph glands may cause a necrotic mass, showing areas of reparative fibroblastic reaction, which gradually involves the parietal peritoneum or involves the colon at its splenic flexure, causing the usual

peritoneal and omental reaction to inflammation, until a large, more or less necrotic, more or less solid tumor-like mass has formed in and about the colon, often resulting in obstruction and usually very difficult to differentiate grossly from a malignant tumor. Case 6 illustrates this condition very well (Fig 4).

Occasionally, without any discoverable atrium of infection, a patient develops swollen inguinal lymph glands, and a mass of infected glands just above and under Poupart's ligament can be palpated. The mass gradually enlarges and after several weeks shows evidence of pus. At operation the parietal peritoneum is involved and the iliac vessels are intimately attached to the mass.

In one such case of mine, the mass bulged into and involved the intraperitoneal cavity near the cæcum. In attempting to free the granulomatous mass, it was opened and pus escaped. Simple drainage was instituted. The pathological report stated that the mass was made up of chronic granulation tissue. No secondary operation was performed as the mass disappeared and patient completely recovered. There has been no evidence of recurrence in this case operated upon 8 months ago.

Just as a diverticulitis of the sigmoid can form a huge mass and involve the bladder in its extension, with a subsequent rupture into the bladder and the formation of a vesico-sigmoidal fistula, so can the process be reversed, the extension taking place from the bladder to the sigmoid or other intestinal loop.

Dr Harry Culver, 2 years ago, asked me to assist at an operation upon a patient with a vesico intestinal fistula. In this instance if the fistula had not developed the mass could easily have been mistaken for an extension of a malignant process from the bladder.

Patient had been treated first with a cautery for a papilloma of the bladder some 2 years previously. This was followed by the application of a needle of radium to the area. For 1 year patient had had signs of a vesico intestinal fistula. At operation we found a fairly large mass extending from the bladder wall to the sigmoid. This was carefully freed, exposing the opening in the sigmoid and in the bladder with the fistulous tract about 2 inches in length running through the mass. The mass and tract were removed and the openings in sigmoid and bladder were closed with pursestring sutures. Patient made good recovery, no sign of recurrence after 2 years.

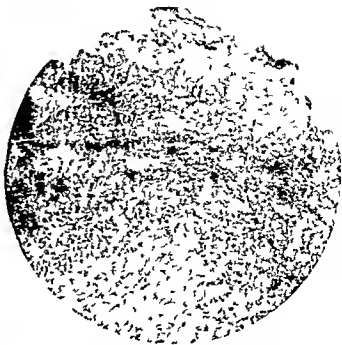


Fig 7 Photomicrograph of case described in Figure 6

Constriction of a hernial sac with the chronic inflammatory changes in the omentum within the sac, the adhesions to the involved loop of bowel, the thickening of the walls of the sac, and the extension of the low grade inflammatory reaction to or from the extraperitoneal tissues, especially the glands, gives one of the best examples of this chronic inflammatory hyperplasia due to the interference to circulation at the constricting neck of the hernial sac.

3 *Trauma—surgical accidents or extraneous injuries* The importance of trauma in the formation of these obscure intra-abdominal tumor masses, so often mistaken for malignant tumors, has never been sufficiently stressed. No case of granuloma the direct result of an accident, such as from an automobile or a fall, has ever been reported, I believe.

Under surgical traumas or extraneous accidents we have the following examples (1) ligatures or sutures which constrict and act as a local interference to the blood supply, or sutures which act as a foreign body, (2) foreign material, such as instruments, sponges, etc left in the intra-abdominal cavity, and (3) trauma in general.

In one of my cases (Case 7) the inflammatory granulomatous mass developed around



Fig 8 Traumatic hernia containing an infective granuloma protecting an undiagnosed tear of the small intestine

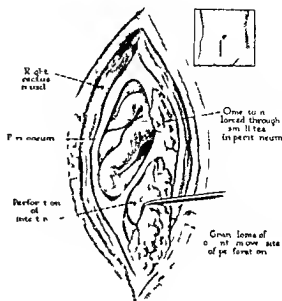


Fig 9 Schematic drawing of condition illustrated in Figure 8

the linen pursestring suture applied during an appendectomy several months previously (Fig 5)

Teitze reports a "granuloma of the cecum following an appendectomy" and in the center of the tumor mass the silk pursestring suture was found

L L McArthur tells me that he observed a similar granulomatous tumor mass about the silk ligatures of a gastro enterostomy. I have operated upon one case who, 5 years previously, had had a gastro enterostomy performed, and found such a large mass of chronic inflammatory tissue that I could not remove it. Later, another surgeon operated and succeeded in removing the mass. Many have noted a subsidence of the condition after simply exposing the mass. This may have accounted for the success of the second surgeon.

Cases have been described of gangrene and pericolic masses following undue ligation of the mesentery

Massive ligatures of the omentum have likewise resulted in inflammatory hyperplasia with adhesions extending to and matting together adjacent loops of bowels. Chronic

inflammatory enlargements of the stump of the omentum following ligation of a portion of it for hernia or appendicitis were first described by Coley, in 1901, and later by Braun. In 1907, Le Roy gave an exhaustive study of the condition. Bull, as early as 1893, described a case of enlargement of the omentum, which occurred months after an operation and resembled malignant growth.

Chronic inflammatory tumor masses of the abdominal wall following the use of non absorbable suture material have been described. Schlosser reports 4 cases of radical operation for hernia in which silk buried sutures were used. In 2 cases there were infections and in 2 primary union. Later the appearance of a mass or a swelling about the scar, the swelling appearing within several months in 2 cases, 1½ years in 1, and 5 years in the fourth. Re-operation in each case revealed connective tissue masses with the sutures the nucleus in each mass. Small amounts of pus were present in each case and in two staphylococci were found. Richter reports a case of abdominal wall tumor around metallic sutures used in a hernia.

2 Foreign material, such as instruments, sponges, etc left in the intra-abdominal cavity is a surgical accident productive of these inflammatory granulomatous masses

In 1920, a patient was admitted to the service of A E Halstead at St Luke's Hospital (H E Mock, Junior on Service)

For the last year patient had noticed a swelling gradually increasing in size in the upper right quadrant of the abdomen. Occasionally he had had chilly sensations and slight fever. For one week previous to operation, tenderness had developed over the upper abdomen. There was some loss of weight, not marked. The diagnosis was tumor or abscess of the liver. Patient had been operated upon in another city for gall stones some 10 years previously. He had been in good health until 1 year ago. At operation we found a large, solid tumor, apparently of the liver, containing areas of necrosis on the surface. It was possible to free this tumor from the anterior surface of the liver by blunt dissection. The tumor was about the size and shape of a large placenta, some 4 inches in thickness. Dr Halstead thought it was most probably a sarcoma. Later, in the laboratory, it was found to be a granuloma formed around a small towel evidently left in the belly at the gall bladder operation. Patient recovered.

Wagner reports a case in which a tumor following laparotomy occupied a large portion of the abdominal wall.

The tumor was adherent to the caecum and omentum. At operation it was thought to be a sarcoma, and microscopic examination failed to reveal whether it was a sarcoma or an actinomycosis. Later, when the dressing was being done, a large abscess cavity was found containing part of a metallic instrument used at the original operation.

3 Under traumas in general many interesting examples of the development of these granulomata can be found.

Author's Case 8 is descriptive of an obscure injury to the abdomen, resulting in an undiagnosed tear of the mesentery followed 3 months later by an intestinal obstruction due to the formation of a constricting tumor mass which proved to be inflammatory. I have found no reports of a similar case (Fig 6).

Case 9 illustrates another tumor mass due to a severe blow on the abdomen which resulted in an undiagnosed rupture of the small intestine (Figs 8 and 9).

In Case 10 the tumor mass was more rapid in formation and resulted from a small tear in the mesentery and a partial volvulus and a

piling up of an inflammatory reaction in the omentum.

Dr S W McArthur gave me the following unreported case in which he feels that trauma was the exciting cause.

In 1925, a man engaged in steel riveting consulted him because of a swelling in right lower quadrant. It was so prominent that the doctor could see the swelling plainly as the man lay on the examining table. It was a hard tumor which had been increasing in size for several weeks. At operation a tumor the size of a coconut and involving the caecum and with loops of gut adherent to it, was exposed. A diagnosis of malignancy was made. A small section was removed for biopsy as the tumor was considered inoperable. The laboratory report came back as chronic inflammatory hyperplasia. The man recovered and within 3 weeks the mass had disappeared. Four months later there was a recurrence of the condition and Dr McArthur again operated upon him. At this time he removed an inflamed appendix from the center of a re-forming mass.

This patient held the blunt end of the riveter against his abdomen, making strong pressure exactly over the appendix region. It was thought that this long continued trauma accounted for the chronicity of the condition.

Foreign bodies involving the intestinal tract or left in the abdomen by surgeons have been mentioned. Foreign bodies penetrating and remaining in the abdominal cavity likewise form the nucleus of a granulomatous mass.

Dr George W Morse, of Boston, has written me of a case injured by a board flying back from a circular saw and striking patient forcibly in the abdomen.

Patient was treated for severe contusion and laceration of abdominal wall without operation. A year later patient developed a tumor in the abdomen in region of umbilicus and extending partly into right lower quadrant. Laparotomy revealed omentum and intestines more or less adherent over a tumor mass which seemed to be retroperitoneal. In exposing this mass more thoroughly it ruptured and pus escaped. It seemed to be thick, somewhat necrotic granulation tissue and in the portion containing pus a splinter of wood approximately 3 inches long was found and removed. Drainage only was done with complete recovery of the patient.

All of the conditions mentioned form the etiological basis for the development of these infective granulomata, so uniformly characteristic in their behavior that they deserve to be considered as a definite pathological entity.

SYMPTOMATOLOGY

The symptoms can be divided into three types (a) inflammatory, (b) obstructive, and (c) constitutional. In some cases only one of these conditions will exist, while in others all three may co exist.

Inflammatory type In the inflammatory type the condition is characterized by varying degrees of abdominal pain, usually mild, nausea or vomiting and local tenderness. As a rule these symptoms are of long standing and there is a history of relief and exacerbations. Fever, seldom more than 100 degrees, is frequently present but not constant and is occasionally accompanied with chilly sensations. A leucocytosis of 12,000 to 15,000 is generally present with polymorphonuclear cells predominating. The picture may never exceed that of a low grade infection while in a few cases a severe attack may develop which resembles acute appendicitis or diverticulitis.

On examination, a definite mass or indurated area can frequently be palpated. This usually is so definite that a tumor is at once thought of.

Obstructive type The chief symptom is exacerbations of colic like pain and constipation finally developing into the severe abdominal pain and obstipation of a partial or complete obstruction. Usually by the time obstruction symptoms develop the low grade fever, leucocytosis and local tenderness have also become a part of the picture.

The finding of the tumor mass with obstruction practically always results in a diagnosis of carcinoma. Or if the inflammatory symptoms accompany those of obstruction a diagnosis of tuberculosis of the bowel is often made.

Constitutional symptoms of loss of weight, loss of appetite, anxiety neurosis especially fear of a malignancy, are frequently present.

X ray examination will usually reveal evidences of obstruction in the obstructive type whereas this evidence is usually absent in the type giving inflammatory symptoms. Early X ray pictures are frequently negative whereas a later X ray film in the same case reveals a defect or developing obstruction. The X ray often only further confuses the diagnosis. On the other hand escape of the barium into finger like projections, pouches

or pockets in the mass is very suggestive of granuloma. Care must be used in selecting the case for X ray examination as the barium meal may produce complete obstruction in the partially obstructed case.

DIAGNOSIS

The terms "pseudo tumors" and "false cancers" are sufficient to indicate the great difficulty of differentiating these inflammatory masses from true tumors. They are usually diagnosed as carcinomata, less frequently as tuberculosis of the intestine, and occasionally as sarcoma. Several authors state that the diagnosis is impossible prior to operation (Kocher).

As one becomes more and more interested in these strange granulomatous masses, he is led to suspect the condition more often and thus will be able to diagnose some of the cases prior to operation. The low grade fever, the leucocytosis, the history of some of the traumas that often precede the condition with the finding of an obscure mass, warrants a probable diagnosis. If the X ray findings show the finger like projections into the mass, his diagnosis is strengthened.

The following short resumes of incorrect diagnoses best illustrate the differential diagnosis.

Tumor of the liver Mrs. B. daughter of a former professor of Rush referred by Dr. S. S. Slaymaker with a diagnosis of gall stones, had typical colic like attacks, slight temperature, jaundice and leucocytosis of 28,000. She was operated upon by the author and several large gall stones were removed. Patient made an excellent recovery and was discharged after 3 weeks. Temperature normal, wound healed, but with a leucocytosis of 24,000 still present. After 6 weeks she began to have a slight fever and increase of white count to 36,000. She returned to the hospital and after several consultations it was decided that a liver abscess was present. Again operation was done and one bluish red nodule the size of an English walnut was found on the anterior surface of the liver. Aspirating needle exploration of the liver in all directions failed to reveal an abscess. Small sections of this nodule were removed and laboratory diagnosis was 'inflammatory hyperplasia'. Search of the literature revealed that Living had described a solitary bluish nodule of the liver under Hodgkin's granuloma. Patient had periods of improvement and then exacerbations of fever with increasing white count finally reaching 78,000. Death occurred 10 months later. At autopsy three of these

small tumor masses of the liver were found, also enlarged mesenteric glands with bluish pigmented cut surfaces. Final correct diagnosis was lymphosarcoma.

Granuloma of pancreas, diagnosed carcinoma Mrs H., referred by Dr N C Gilbert with a diagnosis of gall stones with common duct obstruction. Patient had had her first attack of gall-stone colic on Saturday and entered the hospital on Monday. She had a temperature of 100 degrees, marked tenderness and rigidity over gall bladder region, and severe jaundice. She was operated upon on Thursday. Two large gall stones were removed. There was no stone in the common duct, but a stony, hard mass the size of a baseball and involving three fourths of the pancreas was found. Fine, recently formed fibrous adhesions bound the duodenum and stomach and some of the omentum to the mass. Enlarged glands were also present. Several doctors present at the operation, who could easily see the tumor agreed with me that this was very probably carcinoma. A small section was removed for biopsy. We were so positive of our diagnosis that Dr Gilbert and I told the husband that his wife probably had cancer. Laboratory diagnosis after a week was inflammatory hyperplasia of pancreatic tissue. Patient made an excellent recovery. With drainage of gall bladder jaundice disappeared within 2 weeks. No mass could be palpated after wound had healed. Patient is in good health after 8 months. She has gained 25 pounds in weight.

Inflammatory granulomatous mass of pyloric end of stomach, diagnosed carcinoma (see Case 2)

Inflammatory mass of pyloric end of stomach, diagnosed gall stones (see Case 3)

Carcinoma of caecum, diagnosed infective granuloma H B., aged 40 years, switchman, gave a history of having had appendix removed 1 year previously. He entered the hospital on account of pain in the lower right quadrant, obstructive symptoms and loss of weight. A mass could be palpated in the neighborhood of the caecum. Coming shortly after Case 7 (granuloma with pursestring suture in center of mass) and with similar symptoms I diagnosed the condition as granuloma. Wassermann reaction was negative. Operation disclosed a circumscribed mass which could be freed and removed by resection of caecum and anastomosis of ilium and ascending colon. Laboratory study proved this to be a true carcinoma.

Actinomycosis of sigmoid, diagnosed carcinoma (Gilbert), *infective granuloma* (Mock). Miss F., aged 55 years, referred by Drs Harry Culver and N C Gilbert with a diagnosis of carcinoma of the sigmoid. Patient had been sick 3 months with weakness, loss of weight, and slowly increasing obstruction symptoms. X ray study showed a constriction in sigmoid but with irregular projections of the barium into a mass about the sigmoid. Because of these findings Dr Jenkinson of the X ray department and the author diagnosed a diverticulitis with granuloma. Operation revealed a large mass the size of a cocoa-

nut with semi necrotic areas and involving the left tube and ovary. The mass could not be removed, therefore a section was taken and also the left ovary was removed. A colostomy was performed. Pathological study of section and of ovary revealed the condition to be a specific granuloma due to actinomycosis. Patient died 2 weeks later.

Infected mesenteric lymph glands This patient, a boy 18 years old, gave a history of severe tonsillitis 6 weeks previous to entrance to the hospital. On admission he had severe pain in the left perinephritic region, marked tenderness and rigidity in same region with extension over the upper part of the left abdomen. Temperature was 102 degrees and white count 18,000. Diagnosis of perinephritic abscess was made, and the patient was operated upon by the genito urinary service. No abscess was found. The wound was closed. Patient continued to have a temperature and high white count and 1 week later he was referred because of possible abdominal condition. A point of extreme tenderness and suspicion of a mass were located over the descending colon. Diagnosis of possible diverticulitis with granuloma or "this is possibly a case of enlarged mesenteric glands and retroperitoneal glands, the result of severe tonsillitis. Because of the obscure nature of the findings feel justified in laparotomy" (case note). Operation revealed a definite enlargement of the mesenteric glands and glands could be felt retroperitoneally, no other pathological findings. Patient made a good recovery. A later X ray of the gastro intestinal tract revealed a small duodenal ulcer which Dr Jenkinson of the X ray Department felt showed a perforation. This may have been the source of the infection.

Tuberculous granuloma of intestine This is a condition usually found in children or very young people. The caecum is the commonest site of the tumor mass. Bovine tuberculosis is more often the cause of the condition. The differential diagnosis from an infective granuloma must usually be made in the laboratory.

Syphilitic gumma of the gastro intestinal tract is rather rare. The slow progress of the condition and the positive Wassermann warrant instituting anti syphilitic treatment and the disappearance of the condition leads one to this diagnosis.

Anthrax and blastomycosis must be considered but here again the true diagnosis will usually be made later in the laboratory.

TREATMENT

It is my experience, and many authors so state, that frequently these tumors disappear after sidetracking of the intestine or even after simple exposure of the tumor mass.

When the inflammatory nature can be diagnosed at operation, and obstruction symptoms are absent, local removal, or, if pus is present, drainage only will usually result in cure.

When definite obstruction is present resection of the bowel or, if the tumor is so extensive that this is impossible, a sidetracking anastomosis is necessary.

When on exploring the abdomen, one finds a large inoperable mass and is quite positive that this is malignant, he should nevertheless remove a section for biopsy. The laboratory study may reveal the condition to be an infective granuloma. Thus the surgeon will avoid making a fatal prognosis on a so called cancer case that later recovers.

If, after deciding the tumor is malignant and inoperable, the biopsy proves it to be infective granuloma then one should wait to see if the mass will disappear. But if the inflammatory symptoms persist or if obstructive symptoms develop then one should certainly re-operate.

CASE REPORTS

CASE 1 Five years ago Mrs S B 60 years of age a widow of a Chicago physician was referred to me by Dr Eugene Talbot, for operation on account of gall stones. In securing her history she related that 19 years previously she was in Berlin when she became sick. She cabled her husband who advised her by cablegram to consult Prof R Dittmar. She did so and a tumor in the lower left quadrant of her abdomen was diagnosed. Prof Dittmar, a noted surgeon operated and found an inoperable carcinoma. The patient was told of her condition and a letter with drawings of the tumor mass was sent to her husband. This patient gave me the original drawing of this tumor, made by Prof Dittmar who explained in a footnote that the tumor was inoperable carcinoma of the left tube, left ovary and sigmoid (Fig 1). Patient stated that for 2 years following this operation she was an invalid expecting any day to die but at the end of that time she began to realize that she was growing better and stronger every day. Meanwhile her husband died fully expecting that his wife would soon follow him to the better land. But with the exception of gall stones she has been in excellent health all these years. Her one request was that at this operation for gall stones I should explore her sigmoid to see what had become of her cancer. On opening her abdomen with a wide incision and before removing a large number of gall stones, I carefully explored the entire abdominal cavity and especially the left lower quadrant. There was absolutely no sign of a tumor mass nor even adhesions at the site of the original condition. Knowing the reputation of Dr Dittmar one must acknowledge that a tumor like mass existed, but it must have been an inflammatory mass possibly arising from a diverticulitis of the sigmoid forming an infective granuloma instead of an abscess. Patient is still in excellent health.

CASE 2 Miss T S, aged 56 years, entered St Luke's Hospital April, 1928, on service of Dr N C Gilbert. She gave a history of stomach distress for years with vomiting shortly after meals and marked loss of weight during the last 3 months. Her weight at this time was down to 86 pounds. X ray examination showed a constricting defect near the pyloric end of the stomach. She was referred to author for operation with the diagnosis of carcinoma. A gastroenterostomy seemed indicated to relieve her starvation and vomiting. On exposing the stomach a mass the size of an orange was found involving all the pyloric end of the stomach. There were many enlarged glands along the greater curvature of the stomach but no nodules on the liver. The mass was freed from the pancreas and surrounding tissues and it was felt that a stomach resection with removal of this malignant growth was possible and therefore this was done and successfully. Even after removal we were positive the gross specimen was carcinoma and the relatives were so informed. A few days later the laboratory report came back with the diagnosis of 'inflammatory granulomatous tissue'. Patient made good recovery and at the end of a year had gained weight to 140 pounds. She is still in good health.

CASE 3 Mrs J W aged 52 years, married, no children developed a sudden acute pain in upper abdomen while away on vacation in February 1929. Pain was colic like in character and accompanied with profuse vomiting. She was advised to return home at once and went directly from train to hospital. Examination revealed marked tenderness and rigidity in upper abdomen pain shooting to right shoulder. Patient was still vomiting but no blood was found in vomitus. Temperature was normal, leucocyte count 12,000. No jaundice. Diagnosis of gall stones with possible empyema of gall bladder made. At operation gall bladder was normal but a tumor the size of an orange and involving most of the lesser curvature of the stomach was found. This was thought to be carcinoma. After considerable difficulty, a stomach resection was done almost two thirds of the stomach being removed. The pathologist and internist both agreed with author that the gross specimen resembled carcinoma. However one week later the report came back from the laboratory as 'inflammatory hyperplastic mass'. Patient recovered and has been well ever since.

CASE 4 F D Italian aged 38 years referred by Dr Eugene Talbot in November 1918. Patient had a palpable mass in upper abdomen with marked pyloric obstruction symptoms. He had lost 30 pounds in weight. Dr Talbot diagnosed condition as a granuloma about the site of a gastric ulcer. At operation a large, unencircumscribed mass was found involving all the pyloric end of the stomach, part of the duodenum and pancreas. An effort was made to remove the mass by a stomach resection. Only a part of the mass could be removed. The end of the duodenum was closed, the defect in the stomach sutured, and an anastomosis of stomach and jejunum

done. The patient died on the third day. Laboratory diagnosis was "inflammatory hyperplastic mass." I believe if a simple gastro enterostomy had been done without an effort to remove the mass, which resembled cancer, the outcome in this case might have been different.

CASE 5. Mrs. T. R., aged 45 years, referred by Dr. E. D. Skeen, of Gary, Indiana. This patient had been operated upon 6 months previously by Dr. Skeen. At that time he found a large tumor mass of the omentum located chiefly in the left side of the abdomen on the level of the umbilicus. A section was taken from tumor mass for biopsy and the abdomen was then closed. It was reported as chronic inflammatory hyperplasia of the omentum. The mass remained palpable and as the patient was beginning to have obstruction symptoms, the author was called to Gary to re-operate. Upon opening the abdomen a thickened, nodular, and very firm omentum was found forming a definite tumor mass just above the left lower quadrant. It was fairly adherent to the small bowel from which it was finally freed. Below the omental mass, loops of the small intestine were found more or less closely bound together by thin, fibrinous, and fibrous bands of adhesions, the typical picture of a localized adhesive peritonitis. Three of these loops were so kinked as to be almost completely obstructed. The fibrous bands between these loops could not be torn away as could many of the fibrinous bands, but it was necessary to cut these. As completely as possible these adhesions were removed and then all of the thickened, granulomatous portion of the omentum was resected. The bowel itself showed no evidence of pathology other than the partial obstruction due to these external bands. The patient recovered but for 2 years was in poor health. A recent letter stated that she was now quite well.

CASE 6. C. B., white, male, aged 20 years. Patient entered St. Luke's Hospital on January 3, 1926, on the service of Dr. N. C. Gilbert. There was a history of loss of weight amounting to 15 pounds in the last 6 weeks, productive cough, lassitude, and pain in the left lower quadrant. Patient states that he was in good health until about 1 year ago when he began having attacks of tonsillitis. The last attack was 6 weeks ago and was very severe. On two occasions during the past year he had suffered pain in the left side of his abdomen, accompanied by vomiting, chills, and fever. There had been no diarrhoea or constipation. The diagnosis on admission to the hospital was perinephritic abscess.

Examination showed the left side of the abdomen was very tender with an irregular mass easily palpable just below the left costal margin. This mass seemed to extend backward and upward, it was impossible to say whether this mass originated from the kidney region or from the splenic flexure of the colon. The white blood count ranged from 14,000 to 18,000, the differential blood count was normal. Red blood count 4,200,000, haemoglobin 78 per cent. The urine was negative on repeated examinations.

Sputum examinations were negative. Temperature was 99.6 degrees, pulse 100, respirations 22.

A gastro intestinal X ray examination at this time showed a definite filling defect involving the proximal portion of the distal colon with a definite narrowing of the transverse colon. The pathology corresponded to the mass and seemed chiefly located about the splenic flexure area. Below this area were a number of small shadows which had the appearance of diverticula. Four different pre-operative diagnoses by four different consultants were made on this case, viz. perinephritic abscess, diverticulitis of the colon, tuberculous granuloma similar to those seen about the caecal area, and malignancy.

Patient was operated upon by the author on January 7, 1926. A left rectus incision 6 inches long was made and a mass about the size of a fist was found completely surrounding the splenic flexure of the colon. The mass was chiefly a firm, irregular tumor with areas of softening resembling ulceration. The omentum and greater curvature of the stomach were adherent to the mass above. The majority of the mass extended posterior to the colon. The pathologist was present at this operation and agreed with all the doctors who were standing about that the mass resembled a malignancy more than anything else. A section was taken and immediately examined by the frozen section method. The report was malignancy, most probably small round celled sarcoma. Meanwhile, a considerable portion of the tumor posterior to the colon had been removed. The remainder of the tumor so involved the bowel that resection would be necessary. When the frozen-section report came back, it was decided that a two stage operation was most feasible and therefore a loop of the transverse colon was brought outside the abdominal wound preparatory to making a colostomy opening a few days later. The abdomen was then closed. The father of this boy was informed that his son had a malignant tumor and that the chances of recovery were very slight.

Four days later the following pathological report was submitted by Dr. Edwin F. Hirsch, pathologist at St. Luke's.

"Tissue from around splenic flexure of colon. These two pieces of fat and fibrous tissue markedly reddened are 7 by 4 by 1.3 centimeters and 3.5 by 2.5 by 1.5 centimeters. On each is a dark red granular surface, on the larger 4.5 by 3.5 centimeters, on the smaller 3.5 by 2 centimeters which is like granulation tissue. Cut across, there is considerable yellow fat and white tissue like fibrous tissue. The frozen sections were regarded as containing (1) granulation tissue, and (2) possibly fibrosarcoma tissue. There are five more fragments of tissue like those already mentioned, together equal to a mass 6 by 5 by 2 centimeters. Microscopic examination shows that large portions of this tissue are dense hyalinized fibrous tissue and the portion corresponding to the reddened parts is a zone of oedematous granulation tissue containing many polymorphonuclear leucocytes. The changes in the granulation tissue are not

like tuberculosis. In the 85 sections of tissue examined from different levels and different blocks, there are no tissue changes except those of chronic inflammation and those associated with the healing of chronic granulation tissue. In no section is there tumor tissue. Diagnosis: chronic infective granulation tissue.

Two days following the operation patient developed a very marked fecal fistula. This persisted for 2 weeks. At the end of that time patient began passing fecal material from the rectum normally. At the end of 3 weeks the transverse colon was returned within the abdominal cavity. This was immediately followed by a recurrence of the fecal fistula which persisted for 10 days. Following this, patient again developed normal bowel movements. During his convalescence he showed a very marked loss of weight, loss of appetite and periodic spells of nausea. He was in the hospital approximately 3 months. Patient now is in excellent health and has been for 4½ years (Fig. 4).

CASE 7. Mrs. M. J. aged 22 years, white, no children. Patient first entered St. Luke's Hospital on February 5, 1922, on the service of Dr. Eugene Carey, complaining of nausea, loss of appetite, constipation and tenderness in right lower quadrant. In August 1919 patient underwent an appendectomy. The attack of appendicitis had not been very severe and no drainage had been necessary. Patient was free of symptoms until January 7, 1922, when following the eating of a big dinner she complained of distress in the abdomen with nausea the following day. Since then she has had loss of appetite, nausea, nervousness, irritability and constipation with occasional attacks of tenderness in the right lower quadrant. Other symptoms were negative. The menstrual history was normal. At this time physical examination revealed slight tenderness over the cecum, colon definitely spastic. Gastrointestinal X-ray examination at this time showed colon filling readily with no defects or obstructions, tip of cecum irregular with the constriction at the terminal of the ileum about one inch from the ileocecal valve, some infiltration extending downward from the cecum which is regular in outline and may be due to an abscess. A diagnosis of adhesions around the cecum with probable abscess was made. The leucocyte count at this time was 7,800, red blood cells 4,370,000, hemoglobin 81 per cent. Patient was discharged from the hospital after 3 days of observation.

Patient was referred to the author 10 days later by Dr. Eugene Carey and Dr. M. L. Blatt. At this time patient stated that her general physical condition had improved but she was still having the occasional attacks of distress in the right lower quadrant and the tenderness in this area was becoming more and more sensitive. There was a history of loss of weight and appetite for the past 3 or 4 months and at various times she had had fever in the afternoons. She was referred at this time because of a definitely outlined mass in the right lower quadrant. Examination of abdomen revealed tenderness and rigidity

of her right lower quadrant. A mass about the size of a fist was palpable over McBurney's point. The mass was not movable. The liver was definitely palpable, the spleen not palpable. Temperature was 99.4 degrees, pulse 100, respirations 22. Leucocyte count was 16,000 on the first day and 14,000 on the second. Red blood cells numbered 4,300,000. Hemoglobin was 80 per cent. Vaginal examination showed the pelvic organs normal but the mass could be felt through the right vault. The general physical examination was otherwise negative.

On second day after admission patient was operated upon the incision being made over the appendiceal region. A large, well defined tumor mass about the size of an orange was found to involve the distal 2 inches of the ileum and the entire cecum. The mass was adherent to the lateral and posterior parietal peritoneum and two areas of loops of small intestines were adherent to the mass. The pathologist of the hospital was present, as arrangements had been made for a frozen section if necessary. He agreed with the surgeon that the mass resembled a malignant growth. A small fragment was removed for frozen section examination. While this section was being made the tumor mass was rather easily freed from its adhesions and delivered from the abdomen with the involved portion of the bowel. Just as this was completed the pathologist reported that the frozen section showed carcinoma. Immediately resection of the tumor and involved bowel was performed followed by a lateral anastomosis of the ileum and the ascending colon near the hepatic flexure. The abdomen was then closed without drainage.

The patient's relatives were informed of the malignant nature of this tumor. Five days later the surgeon and attending physicians were called to the laboratory to examine the regularly prepared sections made from the specimen. These showed instead of carcinoma masses of inflammatory tissue. The microscopic slides showed considerable hyaline fibrous tissue in the intestinal wall at the head of the cecum with focal areas of chronic inflammation. All the slides showed lymphoid tissue and large numbers of polymorphonuclear leucocytes. In several sections there were small groups of giant cells resembling mass cells which had resulted from some foreign body rather than from tuberculosis. The pathological report was infective granuloma of the cecum. (This is the only one of my cases in which the pathologist has used the term infective granuloma.)

In the head of the cecum forming almost the center of the tumor like mass was found a *linen pursestring suture* which undoubtedly formed the nucleus and cause of this infective granuloma. Patient made an excellent recovery and has been well ever since. Two years ago she gave birth to a baby and went through the ordeal without any complications (Fig. 5).

CASE 8. J. M. white male, aged 53 years. Patient entered St. Luke's Hospital on July 30, 1926, com-

plaining of intermittent pain in the lower abdomen knife like in character, always starting under the right costal margin and moving downward to the pelvis across the left lower quadrant. This trouble was of 3 months' duration. Patient stated that he had been injured at work 4 months previously, at which time he sustained a skull fracture and other head injuries. He was in another hospital for 6 weeks and the records showed that he was unconscious for the first 2 weeks. For 2 weeks prior to his discharge from this hospital and for 10 weeks following his discharge, he had been troubled with these cramps. He had suffered a loss of appetite and had lost 110 pounds in weight. Because of these complaints, patient was sent to author for observation.

Physical examination revealed a poorly nourished white male, very thin, with slight tenderness in the umbilical region of the abdomen. No masses were palpable in the abdomen but the small spastic descending colon could easily be palpated. The bowel movements were irregular and suggestive of spastic colon. There was a large left scrotal hernia which had been present for years and which caused no trouble. There was slight edema of both ankles. Physical examination was otherwise negative. Temperature was 98 degrees, pulse 80, respirations 20. Red blood count 4,550,000, white count 6,950, haemoglobin 88 per cent, differential blood count normal. Urine was negative at all times. Wassermann negative. X ray examination showed the gall bladder normal, the gastro intestinal films presented no filling defects and no pathological change in the stomach, small or large intestines except in the descending colon, which showed a spastic condition. A diagnosis of spastic colitis was made.

Patient was placed on small doses of tincture of belladonna and a very soft non-residue diet. At the end of 12 days he was discharged from the hospital relieved of his cramp like pains and showing definite signs of improvement. He was instructed to continue the treatment described. Patient returned to the hospital 4 days later, however, with the same complaints. He was again placed under careful dietary regimen with tincture of belladonna and again showed improvement. He was again discharged on September 22, 1926.

On October 12, patient was brought to the hospital by his wife. He was very sick, the abdomen distended and very marked peristaltic waves were present. There was no marked tenderness nor rigidity. The abdomen was so distended that palpation of any tumor masses was impossible. There had been a marked loss of weight during the last 3 weeks. Constipation was present. With enemas small bowel movements were obtained and patient passed gas readily. Because of evidence of partial obstruction, another gastro intestinal X ray was contra indicated. Temperature, pulse, and respirations were normal. The blood count remained normal. A diagnosis of carcinoma, possibly of the colon, with partial obstruction was made.

This patient was operated upon by the author on October 14. A midline incision 6 inches long was made. Immediately on opening the bowel a marked distention of the small intestine was observed. This distention ended at a small, hard, constricting mass in the ileum, and below this point the bowel was small and flat. This constricted area was about 2 inches in length. Opposite the constriction in the small bowel was a tear in the mesentery resembling a half moon and about 3 inches in diameter. Through this tear was a loop of small intestine which was not constricted and which was easily removed. A diagnosis was made on these findings of an inflammatory granuloma, the result of a slow necrosis followed by a reparative process. The necrosis of the bowel wall resulted undoubtedly from interference to its circulation by this tear in the mesentery.

A resection of the involved portion of the small bowel was done followed by end to end anastomosis, the abdomen was closed without drainage. Patient made an excellent recovery and was discharged on a Wednesday, 3 weeks later. At his request he was allowed to remain at the hospital until the following Sunday when he expected to go out of the city to convalesce. On Saturday night he developed severe pain and swelling in the left scrotal hernia. He was seen by an assistant who reduced the hernia and felt that the patient was in no danger. The author saw the patient early Sunday morning and because of definite induration in the hernial sac immediate operation was performed. A large amount of omentum was incarcerated in the hernia and had become strangulated. There was considerable accumulation of dark, serous material in the sac. Patient was very septic. He died 3 days later from this strangulation.

The pathological report made Dr. E. F. Hirsch, pathologist at St. Luke's Hospital, on the resected bowel follows: "The specimen is a segment of small bowel 3 centimeters long, continuous with a dilated portion 10 centimeters long. The mucosa of the first portion is pink velvety, in transverse folds. Beginning abruptly is a pink, slightly depressed tissue that extends through the distal part of the second portion 8 centimeters and with these structures opened along the mesentery this surface is fan shaped 9 centimeters wide. Beyond this region is pink, velvety, hyperæmic bowel lining in transverse folds. The fan shaped region is made up of many close set, but regular, small papillary elevations that vary in size from 0.5 to 1.5 centimeters. Cut across at this level the mucosa is limited to the surface about 1 millimeter thick, excepting the papillary folds. The width of normal bowel lining is about 5 centimeters at the lateral edges and 2 centimeters in the center. In the mesentery is a mass of fat tissue 8 centimeters long, about 6 centimeters wide, and 2.5 centimeters thick. It contains fibrous tissue and lymph glands as large as 1.5 centimeters with pale gray tissue substance (see sketch). Microscopic examination shows that (A) the polypoid folds in the lining are vascular, chronic granulation tissue

in which the predominant elements are mononuclear cells, many like lymphocytes. Between the folds and in crevices are tissues densely infiltrated with polynuclear leucocytes. The muscular layer contains regions of chronic inflammation. The subperitoneal tissues are oedematous and are changed by a chronic inflammation. The regional fat tissues contain mononuclear cells with a brown pigment like changed blood. (B) There is a hyperplasia of the lymphoid tissue and mononuclear cells in the lymph nodes of the mesentery. (C) This is a small bowel with an oedematous mucosa and submucosa. (D) and (E) resemble (C). With all there is a subperitoneal oedema and chronic inflammation. (F, G, and H) are essentially like (A). Diagnosis: chronic inflammatory hyperplasia of small bowel with stenosis (Figs. 6 and 7).

CASE 9. P. M. male aged 40 years was admitted to my service in St. Luke's Hospital in June 1925. Ten days previously he was struck forcibly in the abdomen over the right rectus and just below the umbilicus by a heavy board rebounding from a circular saw when the saw struck a knot hole. Patient went home as he refused to enter a hospital. He was quite ill for several days but was not persuaded to go to the hospital until 10 days later. Examination on admission showed ecchymosis over the lower abdomen and extending down onto the perineum. There was slight rigidity and tenderness over the right rectus. Temperature and pulse were normal. White blood count 12,000. As patient seemed from his history to be improving, no operative interference was deemed necessary. A week later he was allowed out of bed. The next morning he called our attention to a 'lump' when he stood up. Examination showed a definite true traumatic hernia directly at the point where he was struck. This was operated upon the next day. On opening directly over the hernial mass the bulging peritoneal sac was exposed. On its inner surface was a tear and protruding through this tear was a granulomatous thickened piece of omentum which was buried under the torn margin of the right rectus. It formed a mass about the size of half an egg and when it was freed and brought out into the wound a loop of small bowel was adherent to it. On freeing the bowel from the mass a perforation in the bowel was exposed. This granuloma of the omentum had formed first as a protective agent over the site of perforation, had become mildly infected from the contents of the bowel and had developed a granuloma which was truly a reparative process (Figs. 8 and 9). If the traumatic hernia had not developed we would perhaps never have known of this perforation.

CASE 10. R. D. male aged 28 years, was injured by a heavy pulley striking him a severe blow over the right lower chest and right side of abdomen. He suffered fractures of the ninth and tenth ribs. He was admitted to Roslyn Hospital immediately after the accident. On the fourth day the author was called because patient was suffering excruciating pains in upper right abdomen. He seemed in

great shock, respirations were 36, pulse 120 and thready, temperature 100 degrees and white blood count 14,000. On examination dullness could be obtained over the right lower lung and a few fine rales with distant almost bronchial breath tones. The abdomen was distended and very tender and rigidity was noticeable over all the right upper quadrant. His bowels had moved once in the last 24 hours but had not responded to enemata since then. The differential diagnosis between pneumonia and some abdominal condition was very difficult. I felt that all of the lung conditions could be explained by the fractured ribs and by the fixed diaphragm due to some intra abdominal condition. The marked abdominal findings and the shock could not be explained by the lung findings. Diagnosis was tear of mesentery and hemorrhage.

Immediate operation was performed. Free blood was found in the abdomen. A thickened mass could be felt in region of hepatic flexure. This mass was made up of granulomatous omentum and distended ascending colon. The omentum was freed and was found to be thickened until it was almost the size of an orange. A small tear was present in the mesentery and directly opposite this was almost a complete volvulus of the bowel. The colon was untwisted, the tear sutured and the excessively thickened portion of the omentum removed.

SUMMARY AND CONCLUSIONS

1. Infective granulomata are far more frequent than the literature on this subject would lead one to believe.

2. The condition is directly due to a low grade infection causing an impairment to the circulation or to an impairment of the circulation followed by a low grade infection. In either case there is an inflammatory reaction characterized by a necrosis and a reparative process acting and reacting with a gradually increasing building up of an inflammatory mass until a granuloma reaching even the size of a coconut has formed. Occasionally the reparative process predominates early in the condition and one finds a constricting or stenosing granuloma.

3. Infections within the gastro intestinal tract such as appendicitis or diverticulitis, ulcers either within the stomach or in the intestine, foreign bodies within the bowel lumen, in the wall of the bowel, or lying in the abdomen, such as pursestring sutures, lap pads, or instruments left in the abdomen, splinters penetrating into the abdomen, etc., may be the nucleus for the foundation of an infective granuloma. Trauma is a frequent

cause for the condition especially trauma which results in a tear of the mesentery which allows foreign material to remain in the abdominal cavity or which may cause an undiagnosed and non-fatal perforation or laceration of the intestinal wall. Extraperitoneal inflammations may spread to, or involve, the gastro-intestinal tract in the granulomatous mass.

4 The diagnosis of carcinoma is most frequently made when an infective granuloma exists. Many of our recovered cases of inoperable carcinoma of the gastro-intestinal tract have undoubtedly been granulomata. A more careful study of all cases of infective granuloma will enable an increasing number of correct pre-operative diagnoses to be made.

5 No tumor mass of the gastro-intestinal tract, considered at operation to be malignant and inoperable, should be abandoned without first removing a small section for biopsy. This will prevent a fatal prognosis being made of cancer when later the patient may recover because the condition was infective granuloma.

6 The etiology, the similarity in the chain of symptoms, the characteristic findings at

operation, and the ability to make the diagnosis on histological study, warrant considering infective granuloma as a definite disease entity. In the presence of a tumor mass within the abdomen, the possibility of an infective granuloma should always be taken into consideration in making the diagnosis.

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REPLACEMENT LIPOMATOSIS OF THE KIDNEY¹

ADOLPH A. KUTZMAN, A.B. M.D. F.A.C.S. LOS ANGELES, CALIFORNIA

REPLACEMENT lipomatosis or fat replacement of the kidney parenchyma is of rare occurrence. The finding of fat in an organ in which it normally never is observed has aroused but very little interest on this continent. The European literature while an old one, has brought forth many theoretical discussions concerning its unknown etiology and pathogenesis. Morgagni was the first to mention this condition but his case has been considered as doubtful (Hillman). Although Baader (1778) was the first to give definite mention to fatty changes in the kidney (Lacrampe Loustan). Rayer in 1837 described the first well defined case when he noted "an interesting case of obliteration of the pelvis and all calyces except one which contains a calculus. The kidney is transformed into a fatty mass. The cortex is recognizable only in the upper part of the kidney where it has a layer of pale pinkish color. The pelvis and calyces are transformed into connective tissue strips distributed irregularly in a fatty mass, which has the shape of a kidney."

Godard (1859) made the first systematic review of the literature, reporting 12 personal and collected cases. According to Hillman, 4 of these were doubtful (Morgagni, Laennec, Cruveilhier, Petrequin) leaving 8 proved cases. In 1875, Ebstein reported a single case. Thinking that lipomata of the kidney were very rare Lacrampe Loustan (1881) wrote an exhaustive treatise noting extrarenal and intrarenal lipomata but failed to differentiate replacement lipomatosis from the latter. This led him to consider the cases of Bardet, Barth, Bauchet, Houel, and Laboulene as intrarenal lipomata while in reality they were lipomatoses. A few years later, Rickards (1883) cited another case and collected 3 additional ones (Browne, Heath, Whipham). Isolated case reports have since appeared from time to time (Young—Kelly Burnam, 1902, Morris, 1908, Furniss, 1915, Bacon and Le Count, 1928, 2 cases). The exhaustive

study by Hillman (1924) has added 1 personal and 7 collected cases (Hartman, 2 cases, Grifflon, Israel, 2 cases, Godoroff, Grekov), while the more recent studies by Tiurkoff (1928) and Gimpelson (1929) have recorded 4 additional cases. A diligent search of the literature has revealed but 32 proved cases of lipomatosis of the kidney, and with the personal case herein reported, the total is brought to 33 cases. The American literature is most barren and it is for that reason that an additional case report and complete discussion have been made.

Male aged 56 years cigar dealer, came with the following complaints: (1) continuous dull pain in right kidney region (2) burning on urination, (3) frequency (4) slight chills and fever. The family history was irrelevant. The past history revealed that the patient had a chronic pulmonary tuberculosis about 35 years ago from which he had made a complete recovery.

The present illness began with a nocturia 2 to 3 years ago. No further history until 2 weeks ago when the patient began to complain of a very sharp pain in the right lumbar region which at first radiated into the right shoulder but later moved anteriorly and downward into the external genitalia. These colics would persist for 4 to 5 hours, leaving the patient with a continuous dull lumbar ache on the right side. Frequent urination and burning have been continuously present for the last 2 weeks as well as periods of slight chills and fever. There has also been a loss of appetite, headaches and constipation.

The physical examination showed a fairly well nourished man, good color and not appearing acutely ill. Temperature 99.5 degrees F, pulse 72, respiration 20, weight 142 pounds. Blood pressure 140-90. Examination showed nothing remarkable.

Blood examination showed hemoglobin 89 per cent, red blood cells 4,280,000, white blood cells 9,800, polymorphonuclears 74 per cent, small lymphocytes 20 per cent, large lymphocytes 3 per cent, large mononuclears 3 per cent. Urine examination showed the urine to be cloudy, specific gravity 1.022, light amber in color, no albumin, no sugar. Microscopic examination showed numerous pus cells, occasional epithelial cells, no casts, gram negative bacilli. Intramuscular injection of phthalein was returned in first hour, 30 per cent, in second hour, 25 per cent, a total of 55 per cent. The blood Wassermann was negative. Blood non protein nitrogen was

¹Read before The Clinical Society of Genito-Urinary Surgeons, July 1929, San Francisco.

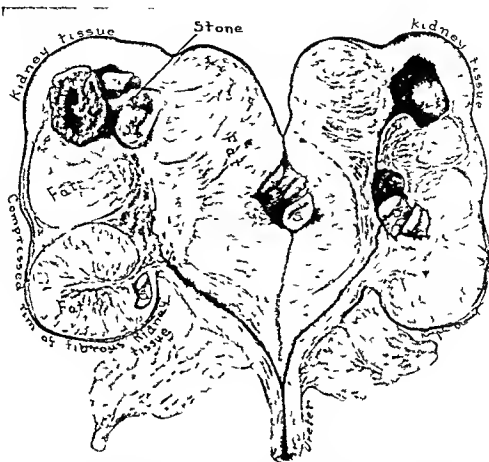


Fig 1: Reproduced illustration of reported case of replacement lipomatosis of the kidney. Note relationship and morphology of the peripelvic pelvic and intrarenal adipose tissue as well as the calculi and remaining damaged renal tissue. The only apparent secreting renal parenchyma is in the upper pole behind a large calculus.

32 milligrams per 100 cubic centimeters of blood. Blood sugar was 89 milligrams per 100 cubic centimeters of blood.

Röntgen ray examination of entire genito-urinary tract revealed 2 very large dense calculi in the right kidney, from 2 to 2½ centimeters in their greatest diameter, one being in the upper pole, one in the lower pole.

Cystoscopic examination. The bladder wall showed a mild diffuse cystitis, negative for stone, tumor, ulcer, etc. There was a slight redness about both ureteral orifices. The trigone and vesical neck appeared inflamed. Both ureters were easily catheterized to the kidneys. The right catheter immediately gave a drip of pure pus following which there was no further drainage during the examination. The urine from the right kidney showed numerous pus and red blood cells with no organisms in the stained smear. The culture grew a hemolytic streptococcus. The left kidney urine showed numerous mononuclear cells and no organisms. The bladder urine contained some pus cells and an occasional epithelial cell, numerous gram positive cocci in chains and a few gram negative bacilli. Acid fast

stains of all specimens were negative. All cultures grew hemolytic streptococci while the bladder urine gave in addition bacillus coli. Phthalein intravenously appeared in 7½ minutes on the left side (the delayed appearance time being due to the left catheter ceasing to drain for several minutes), 25 per cent was returned in the first 15 minutes and 20 per cent in the second 15 minutes with no bladder leakage and no flow from the right side. Pyelographic studies showed an incompletely filled and destroyed right kidney pelvis (Fig 3).

Diagnosis: right calculous pyonephrosis.

Operation. A right intracapsular nephrectomy was done under nitrous oxide-oxygen anesthesia. The kidney was found to be markedly adherent to all structures in the lumbar region especially to the posterior peritoneum and diaphragm. The perirenal fat was not increased in amount, but was very fibrous and tough. These factors markedly hindered the freeing of the kidney from the adjacent structures thus making the intracapsular procedure imperative.

Pathology. The kidney was an oval mass measuring 10.5 by 6.5 by 6.0 centimeters. One end and

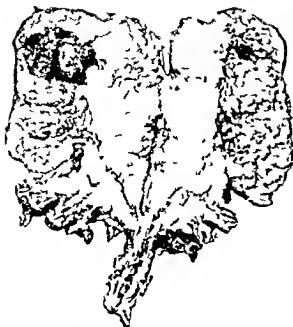


Fig 2 Photograph of the kidney cut sagittally showing the replacement lipomatosis and renal calculi. The process extends throughout the entire pelvis and into each calyx

part of one side consisted of reddish brown tissue resembling kidney cortex. Sharply marked off from this was fatty tissue which made up the other side and end of the mass. Section revealed only a shell of kidney tissue the remainder being fat (Figs 1 and 2). The kidney pelvis, ureter and renal vessels were embedded in the fat, the ureter projecting from the end which appeared to be entirely made up of fat. The calyces contained a number of brown irregular calculi, the largest being a branching stone 3 centimeters long. The calyces extended from the shell down into the fat. The external surface of the fatty mass was definitely encapsulated in some places while in other places the capsule had apparently been torn off. The surface was irregularly lobulated.

Microscopic examination showed the kidney substance to be atrophic and largely replaced by fibrous tissue. The walls of the calyces showed a marked inflammatory infiltration (Figs 10, 11 and 12). There were numerous plasma cells, lymphoid cells and a few leucocytes.

Summary: nephrolithiasis, chronic diffuse nephritis, atrophy of the kidney tissue, fatty mass of renal hilus which was apparently invading the kidney.

As the specimen was unusual it was sent to Dr W. Ophuls of the Department of Pathology of Leland Stanford University who kindly examined it and made the following report:

The renal pelvis is filled with stones and is considerably shrunken. The wall is thick and fibrous.

The kidney is almost totally destroyed and replaced by fibrous tissue. The defects produced by the shrinkage of the renal tissue and by the destruction of some of the calyces are filled with fatty tissue. Sections of the ureter and of the renal pelvis show marked fibrosis of the wall which on the inside shows a layer of granulation tissue. In places the latter is covered by a thin stratified epithelium which resembles stratified squamous epithelium. The slight metaplastic change of the epithelium of the renal pelvis is nothing unusual (Fig 9). The renal tissue is almost entirely replaced by very cellular fibrous tissue in which there are multiple small abscesses. There are few remnants of glomeruli and tubules, marked endarteritis of the smaller arteries (Figs 5 to 12).

Summary: calculi, renal pyonephrosis with shrinkage and fatty replacement of kidney tissue.

Patient made an uneventful convalescence and is still living the operation having been performed over 3 years ago. He still has some residual cystitis. His general condition is fair with some complaints of gastro intestinal disturbances.

This case is definitely a lipomatosis or fat replacement of the kidney, associated with calculous disease. It is typical and similar in all characteristics to the cases reported in the literature. The specimen revealed a large amount of pelvic and peripelvic fat which no doubt must have been the origin of the fat filling the kidney, thereby adding support to the theory that the invasive proliferation of fat begins in the pelvic and peripelvic adipose tissue and follows the destruction (atrophy or compression) of the kidney parenchyma. The rim of kidney tissue surrounding the fibrous fatty mass presents a picture of an overwhelming inflammatory and infectious process with the surviving atrophied elements such as hyalinized and dilated tubules and sclerosed glomeruli and blood vessels, a picture not infrequently found in an advanced hydronephrosis or pyonephrosis. The fat in the kidney was of a tough fibrous variety which is characteristic of replacement lipomatosis of the kidney. The clinical picture was that of a markedly infected calculous kidney disease while the associated fatty condition remained undiagnosed until operation.

PATHOGENESIS

By replacement lipomatosis or fat transformation of the kidney is meant a substitution of the renal parenchyma by true adipose tissue. It has been variously designated in the



Fig 3 Pyelogram showing a small amount of the sodium iodide in the pelvis proper and a large calculus in the upper pole. Since the pelvis and calyces were filled with adipose tissue, a complete pyelogram was not possible.

literature as lipomatous nephritis, lipomatous paranephritis, lipoma diffusum renis, substitutio renis adiposa, lipomatosis renis, fatty transformation of the kidney, fat replacement of the kidney, and fatty degeneration of the kidney. These terms are more descriptive of the latter stages of this pathologico-anatomical process, in which the entire kidney parenchyma may have disappeared. In the earlier stages where the changes are yet to occur in the hilus and polar regions of the kidney, the term "lipomatous paranephritis" has been considered more descriptive by some observers. The process has not been satisfactorily explained. Most dissertations present only a limited discussion, classifying it with the paranephritides. The fat may either surround the kidney or limit itself to individual areas, usually at the hilus or polar regions of the kidney. It

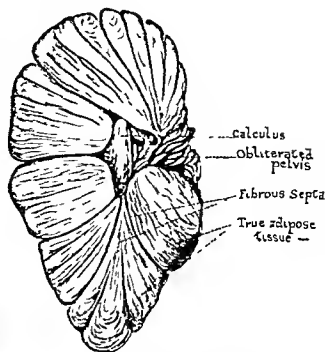
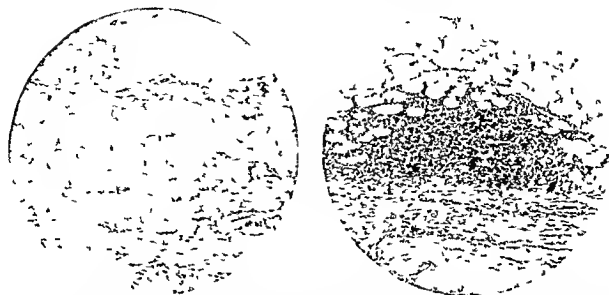


Fig 4 Reproduced illustration of Rickard's case of replacement lipomatosis. Note the resemblance to the reported case.

may even involve the ureter at times, assuming the dimensions of a "colossal fat tumor." The fat substitution usually parallels an atrophying renal process—renal atrophy and fat hyperplasia—a fat tissue accumulation which may push into all parts of the kidney pelvis.

If the process has markedly progressed there may remain only a rim of sclerosed atrophic renal tissue. This has led the French authors to designate the process as "substituto renis adiposa" (Hillman). The pelvis and calyces are entirely obliterated by fibrous fatty tissue. The contour and shape of the kidney are more or less maintained. Cross section of such a kidney usually gives the appearance of a fatty mass with the pelvis and calyces divided by connective tissue strips and septa (Figs. 1, 2, and 4). The cortex can be noted as a thin rim, forming a capsule about the fatty mass. In addition there is the true fibrous capsule of the kidney externally. The fatty mass is in direct association with that of the pelvis, hilus, and peripelvic tissues so that it may appear as one connected fatty mass. This picture is well illustrated by the reported case. Usually calculi are found in either the pelvic fatty mass or in the calyces, occasionally there is evidence of a



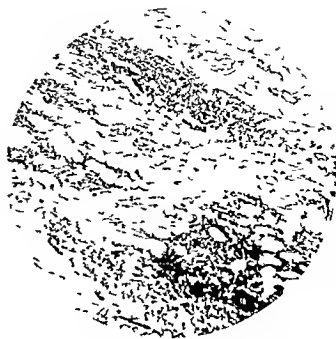
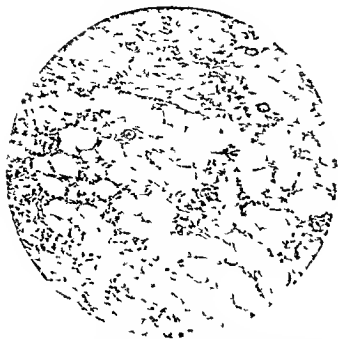
Figs. 5 and 6 Photomicrographs (high power) showing the structure of the adipose tissue found in the pelvis and calyces. Note the rather sharply defined border of the fibrous renal parenchyma. Figure 5 shows a large collection of small round cells between the adipose tissue and the fibrous renal parenchyma to the degree of abscess formation.

pyonephrotic condition without calculi. Microscopically the picture is that of true adipose tissue and bears no direct metaplastic relationship to the renal tissue or neoplastic fatty tumors (Figs. 5 and 6). Areas have been noted where it may appear that the fat has invasive powers by finding evidences of vacuolization in the atrophic kidney parenchyma. Laboulene (Lacrampe Loustan) has described a case in which the cortical and tubular areas showed evidence of invasion and destruction by many fat deposits. This was noted to some extent in the sections of the reported case (Figs. 7 and 8).

Some interesting and speculative theories have arisen as to the source of the fatty tissue and the reason for its penetration into the kidney. Whatever the source of the fat it probably is not from a degeneration or metaplasia of the kidney parenchyma, but from an external source. Todd and Bowman (1853) (Lacrampe Loustan) noted that fatty transformation of the kidney could follow atrophy of the kidney, chronic pyelonephritis from calculous disease or simple inflammation, with an abundant accumulation of fat in the perirenal tissues frequently encroaching on the kidney proper. Houel (1857) as well as Cruveilhier (Lacrampe Loustan) were of the opinion that the renal substance itself is not invaded by the fat, but

more often the kidney atrophies and shrinks but always remains intact. Lacrampe Loustan thought the fatty changes in the kidney to be due to lithiasis. Rickards believes the fat to be developed to fill up space created by the destruction of the kidney parenchyma and that the process is a physiological one "to compensate and prevent a vacuum", that the origin of the fat may be from one of three sources: (1) hypertrophy of the circumrenal fat pushing its way into the kidney through the hilus, (2) hypertrophy of the fat normally found in small amounts in the interior of the kidney between the apices of the pyramids, (3) absorption of fat by the cells forming the stroma of the organ.

Matsuoka has stated that lipomatosis or abnormal increase in adipose tissue is pathological and will cause atrophy and degeneration of the organ wherein situated. He has accordingly divided lipomatosis into two groups: first, where an invasion of the adipose cells from the surrounding into the affected tissue plays a relatively important role and there is a proliferation of fat cells in the interstitium of the affected tissues; second, the organ affected shows primary atrophy of the parenchyma with fibrosis and later lipomatosis occurring as the fibrous connective tissue



Figs 7 and 8 Photomicrographs (high power) showing the invasion in some areas of the destroyed and fibrous renal parenchyma by the fatty tissue and chronic inflammatory elements

cells become infiltrated with fat droplets. The author states that there is no invasion as in the first group. The process is described as replacement lipomatosis following a replacement fibrosis. This type of lipomatosis occurs in patients with wasting diseases. In referring to the kidneys, Matsuoka states that they are exceptions to the first group since fat cells do not pass through the capsule into the substance of the kidney nor do they develop in the interstitium. He gives as his reason that the firm kidney capsule with its dense areolar tissue and numerous elastic fibers protects the kidney from invasion by the capsule fat. As to the second group, Matsuoka states that lipomatosis of the kidney consists entirely in an overgrowth of perirenal fat. It is not a growth of fat cells following fibrosis, but associated with fibrosis. With this fibrosis of the kidney, there occurs also an increase in the perirenal fat. The author has failed to comprehend the hilus of the kidney as a portal of entry for the fat. We shall later revert back to these observations in offering our theory.

Under normal physiological conditions there is only one example of fat replacement in a glandular organ, namely the thymus. It has been found that gradually the specific organ tissue disappears beginning first with the cor-

tical layer, and is replaced by fat and connective tissue. This occurs by penetration of the adjacent fatty tissue between the lobules of the gland, finally resulting in the thymus becoming a globule of fatty tissue by the age of



Fig 9 Photomicrograph (high power) showing a section where the mucous membrane of the renal pelvis has changed to a thin stratified epithelium resembling stratified squamous epithelium. Beneath this is seen the typical picture of chronic inflammation. This slight metaplastic change is nothing unusual and therefore of no significance.



Fig. 10

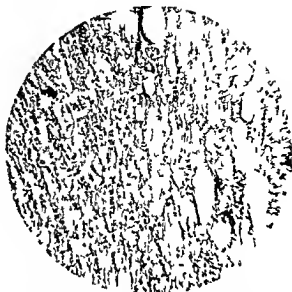


Fig. 11



Fig. 12

Figs. 10, 11, and 12. Photomicrographs (low and high power) from the thinned out area of the remaining renal parenchyma showing the extensive destruction by chronic inflammation and pyonephrosis.

15 years. In various pathological conditions, fatty tissue may develop in the heart and skeletal muscles. This does not include fat deposition in the epicardium but the actual penetration of fatty tissue through the connective tissue between the fibers in nutritional disorders of the muscles. A review of the older literature has shown that Rayer, Cruveilhier, and Rokitsky considered the hypertrophy of fatty tissue as taking place in certain chron-

ic diseases of the kidney, but fatty substitution was noticed only in cases of well defined atrophy of the parenchymal tissue caused usually by a chronic calculous pyelitis or pyonephrosis. There follows proportionally to the atrophy of the parenchyma a proliferation of the fatty tissue of the hilus between the pelvis and calyces into the kidney, but more rarely. Rokitsky stated that in a continuous moderate inflammation of the kidney, usually caused by calculi, there could occur a proliferation of the fatty tissue which might accumulate around the kidney and lead to its atrophy, the fatty tissue gets its impulse for proliferation from the need for replacing the atrophied organ (*hyperplasia ex vacuo*) that is, by what he terms "a biological inertia." Rosenstein (Hillman) accepting the secondary character of the fat proliferation still believed that in some cases the transformation of the gland tissue into fat might be independent of the atrophy. Klebs, however, doubted that it would be possible for the kidney to be compressed by hyperplastic fat tissue. Fedoroff thought that in his case the proliferation of the fibro fatty mass had its beginning in the pelvic fatty cellular tissue, and that the atrophy of

the kidney might be considered as the primary force for the proliferation of the pelvic fat. Israel explained replacement lipomatosis as an irritative hyperplasia of the fat tissue of the fatty capsule of the kidney, while this hyperplasia might be limited to certain parts it usually involved the entire fatty capsule. The basis for this irritative hyperplasia could be any chronic inflammatory process in the kidney that leads to destruction of the kidney parenchyma and the formation of new connective tissue, nephrolithiasis being the usual one. As a rule in cases with infected renal calculi, the perirenal tissues are nearly always affected. With an initial adhesive fibrotic process there may ensue a change to the fibroadipose tissue. This has been designated as a "lipomatous paranephritis." Fatty substitution may then result only if the kidney has been destroyed. In such instances there is a growth of adipose tissue which begins around the capsule and then pushes its way through the hilus. This process may not terminate with just substituting for the disappearing parenchyma, but may call forth a hyperplastic process which in some instances may be confused with a neoplasia. Gimpelson has stated that this pathologico-anatomical process belongs to the "hyperplasia *ex vacuo*," similar to the substitutionary growth of fat following this disappearance of tissue in a parenchymal organ (fat substitution in an atrophic thyroid, fatty growth in pathological lymph glands). The fatty growth *ex vacuo* he considers biologically as an effort of the organism to maintain its weight balance.

In his exhaustive treatise Hillman explains the origin of the fat as follows: (1) the fatty tissue of the adipose capsule in spreading compresses the kidney leading to its atrophy and replaces it, at the same time the hilus tissues penetrate into the kidney, (2) primary atrophy of the kidney follows as a consequent hyperplasia of the fatty tissues, and (3) the fatty tissue replacing the original tissue is developed through metaplasia of the connective tissue of the kidney while a process of atrophy takes place in the latter. The third theory, while being theoretically possible, in reality has little foundation, there is so little connective tissue present in the kidney that there can hardly be

any active part attributed to it. This leaves the second theory as the most plausible and as that most corroborated by the case reports in literature. Hillman believes that if the process of the spreading fatty tissue were an active one, then traces of renal tissue could be found between the lobules, that therefore the fatty replacement is of a secondary nature and is caused by atrophy of the kidney. He feels that while the hilus fat is unable to initiate atrophy of the renal parenchyma it may in those cases in which the process of atrophy is already present, and the fatty tissue is thereby given an impulse to grow and is able to penetrate into the kidney along the vessels, so that it subsequently becomes one of the factors in producing atrophy. For this reason Hillman believes the term "substituto renis adiposa" as the most logical and descriptive.

While the theories concerning the pathogenesis of replacement lipomatosis may appear to be numerous they can be placed in two essential groups. A minority number of authors consider the primary growth to be from the fatty capsule while coincidentally the hilus fat forces its way into the kidney leading secondarily to an atrophy. There is no overwhelming evidence to support this view. The second or majority group of observers hold that the fat substitution is of a secondary character, considering the atrophying process of primary importance. To support the latter view it has been pointed out that at times retroperitoneal lipomata assume huge proportions, surrounding and pressing the kidney on all sides and yet cause no destruction nor atrophy of the kidney parenchyma. If the fatty growth were of a primary nature, histological examination should reveal traces of kidney tissue, which has never been the case. Between the fat tissue and the remaining atrophic kidney tissue there is usually a sharp boundary.

Careful study of my case has led me to believe the calculous disease of the kidney to be the primary and initial factor in replacement lipomatosis of the kidney. Analysis of the 33 collected cases revealed calculous disease in 79 per cent (26 cases out of 33). Of 3 bilateral cases of replacement lipomatosis, 2 had bilateral renal or ureteral calculi. Combined with an infection these results destruction of the

TABLE I—COLLECTED CASES OF REPLACEMENT LIPOMATOSIS OF THE KIDNEY

| No | Name Date | Sex Age | Side | Calculus | Anatomy |
|----|-------------------------------|---------|-----------|---------------------------------------------------|----------------------------------------------------------------------------------------|
| 1 | Baader 1775 | F | Right | Ureteral calculus with suppurative pyelonephritis | Autopsy Fatty kidney found. Center filled with pus |
| 2 | Barth 1815 | | | Stones at ureteropelvic junction | Autopsy Disappearance of cortical substances with invasion of fatty tissue |
| 3 | Bauchet 1851 | M | Right | Right ureteral stone in left kidney | Autopsy Right kidney replaced by a complete fatty mass |
| 4 | Browne 1861 | M 11 | Left | Calculus found | Autopsy Kidney composed of dense adipose tissue |
| 5 | Dupuytren | M 15 | Right | Multiple calculi present | Autopsy Kidney almost entirely changed to fat |
| 6 | Ebstein 1875 | F | Left | No stone mentioned | Autopsy Entire kidney converted into fatty tissue |
| 7 | Fedloff 1891 | F 45 | Right | Stones present | Autopsy Kidney replaced by a fibro-lipose tumor |
| 8 | Fuenes 1905 | F 67 | Left | Calculus present | Operation Kidney converted into a hard, tough fatty mass |
| 9 | Gimpelson 1919 | F 54 | Right | Calculus present | Mass of adipose tissue covered by a thin layer of renal tissue |
| 10 | Gimpelson 1920 | F 44 | Right | Calculus present | Autopsy Kidney all fat with pyonephrotic cavities. Practically no renal tissue visible |
| 11 | Gold 1859 | M 55 | Left | Stone present | Autopsy Suction. Most of kidney changed to a fatty mass |
| 12 | Griffon 1886 | M 65 | Bilateral | Stones in both kidneys | Autopsy Right kidney a fatty mass. Left kidney atrophied with fat and pus perforating |
| 13 | Hartmann 1895 | M 19 | Right | Large renal calculus | Autopsy Kidney showed fatty tissue with remnants of parenchyma |
| 14 | Hartmann 1895 | M 39 | Left | Large renal calculus | Autopsy Fatty mass penetrating into kidney |
| 15 | Heath 1895 | | Left | No stone mentioned | Autopsy Kidney chiefly a lipose tissue |
| 16 | Hillman 1904 | F 56 | Left | Multiple calculi | Operation Kidney composed of fatty tissue containing remnants of parenchyma |
| 17 | Hillman (Grekov) 1904 | F 51 | Left | Multiple calculi | Operation Fatty degeneration of kidney |
| 18 | Houel 1857 | | | No mention of calculi | Autopsy Kidney almost entirely transformed into fat |
| 19 | Huetie 1848 | M 66 | Right | Multiple small calculi | Autopsy Kidney mostly fat with traces of parenchyma |
| 20 | Israel 1901 | F | Left | Stones present | Operation Complete fatty degeneration of kidney |
| 21 | Israel 1901 | F 56 | Left | No stones | Operation Kidney a conglomeration of fat |
| 22 | Kutemann 1917 | M 50 | Right | Multiple calculi | Operation Entire kidney transformed into fatty mass except small area at upper pole |
| 23 | Laboulene | | | No mention of calculi | Autopsy Kidney parenchyma involved and destroyed by fatty tissue |
| 24 | Le Count and Bacon 1918 | F 19 | Right | Multiple calculi | Operation Most of renal parenchyma replaced by fat |
| 25 | Le Count and Bacon 1918 | M 54 | Left | Multiple calculi | Operation Most of renal parenchyma replaced by fat |
| 26 | Morris 1905 | F 54 | Left | Calculus present | Operation Fatty mass occupied entire pelvis and part of parenchyma |
| 27 | Rickards 1891 | M 24 | Bilateral | Calculus in both kidneys | Autopsy Both kidneys transformed into fat |
| 28 | Rayer 1857 | | | Stones present | Autopsy Kidney practically transformed into fat |
| 29 | Rayer 1857 | F 45 | Bilateral | Stones not mentioned | Autopsy Both kidneys transformed into fat |
| 30 | Turikoff 1918 | F 22 | Right | Calculus present | Cross section of the kidney appeared like a solid fatty mass |
| 31 | Whigham 1867 | M 40 | Right | No stone mentioned | Autopsy Kidney almost entirely replaced by fat |
| 32 | Wischnewski (Gimpel son) 1929 | F 54 | Left | Calculus present | Picture of fatty tissue with rests of kidney tissue enclosed |
| 33 | Young (Kelly Burnam) 1902 | | | Calculus present | Renal parenchyma largely replaced by fatty tissue |

TABLE II—DOUBTFUL CASES OF REPLACEMENT LIPOMATOSIS OF THE KIDNEY—INSUFFICIENT DATA

| No | Name Date | Sex Age | Side | Calculus | Anatomy |
|----|------------------------|---------|------|---------------------------------|---------------------------------------------------------------------------------------------------------------------------|
| 1 | Cruveilhier 1856 | | | | Autopsy Kidney metamorphosed into fat Considered doubtful by Hillman |
| 2 | Israel (Case III) 1901 | | | Large calculus in kidney pelvis | Moderate increase of the hilus fat around pelvis as a local proliferation of fat hence doubtful case |
| 3 | Laennec | | | | Cited by Hillman as a doubtful case No data |
| 4 | Morgagni | | | | Cited by Hillman as a doubtful case No data |
| 5 | Pascal 1833 | | | | Autopsy Kidney stripped of its capsule exuded fat and floated on water Insufficient data makes case doubtful |
| 6 | Petrequin 1836 | | | | Autopsy Fatty transformation of kidney accompanied by a hydronephrosis Considered doubtful by Hillman and Lacrampe Loutan |

kidney pelvis and parenchyma until we get the familiar picture of a pyonephrosis. If the fat be removed from the dilated pelvis and calyces the customary outline of an infected hydronephrosis or pyonephrosis can be recognized. This pathological process will compress and destroy by infection the renal parenchyma as is seen in the microscopic picture. It has often been noted that the peripelvic fat shows a hyperplastic tendency in the presence of long standing infections. Tuberculosis is a notable example. The presence of calculi and the chronicity of the infection may therefore result in giving a proliferative and invasive power to the already hyperplastic peripelvic fat about the renal hilus resulting in an invasion around the renal vessels. Resorting to the grouping of lipomatosis as offered by Matsuoka, replacement lipomatosis may then be explained by utilizing the criteria of both groups. First, there may occur the proliferation of adipose tissue externally with invasion through the hilus and renal vessels, a fact not comprehended by Matsuoka, second, with a destruction of the renal parenchyma by the infectious calculous disease, much fibrosis occurs in the remaining renal tissue and with this there may be a concomitant lipomatosis as the fibrous connective tissue cells become infiltrated with fat droplets. Microscopic examination of various sections has shown small accumulations of fat cells in the fibrous tissue (Figs 7 and 8). It is not beyond reason to believe that fat may have invasive powers as has already been noted in some lipomata. With the invasion of the fatty tissue a third destructive factor is added

to the already present calculosis and infection, all 3 of which may continue to destroy or atrophy the already damaged parenchyma. That a calculus may act as a barrier against these destructive factors is well illustrated in the upper pole of the reported case in which the only secreting kidney tissue remaining was that behind the calculus. If replacement lipomatosis be a defensive process why does it occur so rarely and why should pyonephrosis, which is a more destructive process, be the usual outcome? I am unable to answer the question at this time.

Replacement lipomatosis of the kidney is to be distinguished pathologically from fatty tumors in the kidney region. Some observers have either considered or confused replacement lipomatosis with fat tumors of the kidney. True renal lipomata are rather infrequent in occurrence, usually small in size, yellowish in color, found as encapsulated nodules, possessing a fibrous capsule, in the cortical layer directly beneath the fibrous capsule. They result from rests of fatty tissue which have become included in the kidney during embryonal life. Replacement lipomatosis possesses none of these characteristics. Only as a possible simulation between the two, Tuffier states that the pyelonephritides with a chronic course call forth a significant fatty hypertrophy of the fatty capsule, a true perirenal lipomatosis remotely resembling a renal growth. Replacement lipomatosis is not a neoplasm, clinically, anatomically, or pathologically.

There are also the fat tumors of the fatty capsule of the kidney or, more exactly, the

lipomata developed from the fatty tissue found between the fibrous and fatty capsules of the kidney. These tumors are often classified with the retroperitoneal and perirenal lipomata. A third condition to be differentiated is the so-called "myelin kidney" in which in rare instances a large amount of doubly refracting lipid has been laid down in linear deposits which may be seen in the cortex.

CLINICAL STUDY

There are no pathognomonic signs nor symptoms for the clinical recognition of replacement lipomatosis of the kidney. It can be diagnosed only from surgically removed or autopsy kidneys. The clinical picture is dominated by the associated urinary calculosis and infection. Prior to the present century all cases were found at autopsy (19 cases). In 1901, Israel for the first time noted replacement lipomatosis in a surgically removed kidney, as has been done in nearly all cases since (14 cases).

The condition is very rare, 33 proved cases (Table I) as well as 9 additional doubtful cases (Table II) having been collected. A study of these cases has revealed the fact that all presented urinary infection and that 79 per cent (26 out of 33 cases) were associated with renal or ureteral calculi. Of the latter, 3 cases were bilateral (Bauchet, Griffon, Rickards). Replacement lipomatosis of the kidney has been found almost equally distributed as to sides, right, 12, left, 13, bilateral, 3 (Rayer, Rickards, Griffon), not stated, 5. It should be noted that 2 of the 3 bilateral cases also were associated with bilateral calculi, which may be of some significance in considering their pathogenesis. Distribution of the cases among sexes was 12 males, 15 females, and 6 not stated. The age distribution is a wide one, the youngest case being 11 years (Browne) and the oldest 67 years (Furniss). Occurrence as to decades is as follows:

| Years | Cases | Years | Cases |
|----------|-------|------------|-------|
| 0 to 10 | 0 | 41 to 50 | 3 |
| 11 to 20 | 2 | 51 to 60 | 10 |
| 21 to 30 | 3 | Over 61 | 2 |
| 31 to 40 | 3 | Not stated | 10 |

Treatment of replacement lipomatosis *per se* cannot be carried out since the condition is

not recognizable clinically. Judgment must, therefore, be governed by the associated calculous or infectious condition. Hillman has stated that were it possible to recognize the fatty replacement *in vivo* and differentiate it from pyonephrosis, in cases with an obliterated ureter and free from pus, fear for infection of the opposite kidney would be obviated and nephrectomy would therefore not need to be carried out on the affected kidney. Since this is not possible, and furthermore since most of these kidneys are infected, painful and functionless, there being no contra indications, nephrectomy should be the treatment of choice. Surgically these cases are apt to be difficult because of a great amount of perirenal adhesions and paranephritis caused by a long standing chronic renal pathological process.

SUMMARY

1 Replacement lipomatosis of the kidney is a rare disease.

2 Thirty-three cases have been collected inclusive of the personal case herein reported. Nine additional cases were found but these are classified as doubtful.

3 Replacement lipomatosis of the kidney is always associated with a kidney infection, usually intense and with calculous disease in 79 per cent of cases.

4 Replacement lipomatosis of the kidney has a nearly equal distribution as to sex and side involved.

5 Clinically there are no pathognomonic signs nor symptoms. The earlier cases were found at autopsy, while recent specimens have been found in surgically removed kidneys.

6 The pathogenesis is on a theoretical basis of replacement. The process is probably one of invasion by the perirenal, peripelvic, and hilar fat along the large vessels through the renal hilus, following a destruction of the renal parenchyma by calculosis and infection.

7 Treatment is directed to the associated condition and usually is nephrectomy, since these kidneys are painful, badly infected, and functionless.

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ACUTE INTESTINAL OBSTRUCTION¹

ALTON OCHSNER, M.D., F.A.C.S., NEW ORLEANS, LOUISIANA

From the Department of Surgery, School of Medicine, Tulane University of Louisiana, New Orleans

THLRE is probably no condition which causes a surgeon more concern than ileus. The symptoms of intestinal obstruction are usually quite definite but vary considerably according to the location of the obstruction that is whether it is relatively high or relatively low in the intestinal tract and the degree of interference with the blood supply of the affected gut. As is well known mere obstruction of the intestinal tract in the absence of interference with the blood supply to the intestines produces, aside from obstipation, relatively few symptoms and signs in clinical cases. Murphy and Brooks, Nesbitt, the Dragstedts and their co-workers, Gatch, Trussler and Ayres, Foster and Hauser, Hartwell and Hoguet, Howell, Wilkie and Sugito have emphasized the relative absence of signs in experimental animals under similar conditions. The symptoms and signs are more pronounced the higher the obstruction in the intestinal tract. Both clinically and experimentally, symptoms and signs are most marked in those cases in which the obstruction is in the duodenum and at a point just below the openings of the pancreatic and common bile ducts. Brooks and his co-workers and the Dragstedts and their co-workers have shown that in experimental "closed loop" obstructions the shorter the loop the more rapid is the intoxication. Recently Owings, McIntosh, Stone and Weinberg have shown that following intestinal obstruction there is a decided increase in intra intestinal pressure, the pressure varying with the amount of peristaltic activity, the peristaltic activity being greatest in the uppermost portion of the intestinal tract. These observers however found that the maximum pressures at different levels in animals with high and low obstruction do not show great differences. Morton, on the other hand, repeating the experiments of Owings, McIntosh, Stone and Weinberg found that there was considerable difference between the amount of pressure within a loop of duodenum and one

of lower ileum. Whereas the normal intra intestinal pressure varies from 2 to 4 centimeters of water he found that after obstruction had been present for 24 hours the pressure within the duodenum and ileum had increased to from 28 to 36 and to from 4.5 to 5 centimeters of water respectively. This excess in pressure of the upper intestinal tract over that of the lower results from the marked secretion of the duodenal mucosa, as well as from the presence of the biliary and pancreatic secretions in contrast to the absorptive mucosa which is found in the lower part of the intestinal tract. Morton found that the duodenum secreted from 5 to 10 times as much fluid as the ileum in a given period of time. He believes that obstructions low in the intestinal tract are similar to those with long closed loops whereas obstructions located at a higher level are comparable to short closed loops.

Dragstedt, Lang and Millet have shown that there is considerable variation in the intramural blood supply of the various parts of the intestine and as a result of this anatomical variation pressure within the gut exerts varying influence on the blood supply of the gut. They found that the flow in the veins of the wall of the intestine ceased when the intra intestinal pressure within the duodenum, jejunum, ileum, and colon attained a height of 35 to 45, 55 to 65 and 95 millimeters of mercury respectively. This difference they believe, is due to variation in the length of the intramural blood vessels. They found that if a cross section of the bowel be represented by the face of a clock with the mesenteric attachment at six o'clock, the vasa recti pierce the muscularis in the case of the duodenum at approximately five and seven o'clock, in case of the jejunum and ileum at five and three o'clock, and in case of the colon at two and ten o'clock. In the duodenum any increase in intra intestinal pressure exerts considerable pressure on the vessels which lie between the mucosa and the muscularis. In

the colon, however in which the greater portion of the vessel lies outside the muscularis an increase in intra-intestinal tone exerts relatively little effect on the blood supply. Morton and Sullivan also found a richer blood supply in the lower duodenum than in the ileum. The importance of intra intestinal pressure in intestinal obstruction has recently been shown by Raine and Perry, who found that in experimentally produced obstruction of the ileum in rabbits, the administration of rather large amounts of water at frequent intervals caused no evident increase in intra-intestinal pressure, probably because of the absorption of the fluid. If, however liquid abalone were administered, the animal died relatively quickly and showed the same blood changes as those shown by animals with high jejunal obstruction. It can thus be seen that aside from obstipation and certain changes in the blood, which will be mentioned subsequently, the symptoms in intestinal obstruction are not marked unless there is some interference with the blood supply. This decrease in the blood supply, however, may be the result of compression of the intramural vessels produced by an increase in the intra-intestinal pressure and the peculiar susceptibility of the vessels in the upper part of the intestinal tract to compression. The increased pressure in high obstructions is usually the result of both excessive secretion and diminished absorption within the affected part of the gut.

As a result of simple obstruction in the absence of interference with the blood supply to the intestine, dehydration and hypochloremia occur as a result of the loss of fluids and hydrochloric acid in the vomitus. Hartwell and Hoguet, in 1912, believing that the symptoms in acute intestinal obstruction were due to dehydration, found that animals with obstruction could be kept alive over long periods of time by the administration of large amounts of normal saline solution. These observations were corroborated by Draper. The true value of the administration of the normal saline solution was not appreciated until Haden and Orr found that rather typical blood changes occurred in intestinal obstruction, namely, a decrease in the blood chlorides and a rise in the carbon dioxide

combining power of the plasma (alkalosis). Haden and Orr believe that the decrease in chlorides is due to a fixation of the chlorine ion in the tissues by the toxin which is formed within the intestinal tract. As suggested by Cooper, however, these observers did not take into consideration the large volume of fluid present in the dilated portions of the upper intestinal tract of animals. Raine and Perry have shown that in rabbits a typical hypochloremia occurs in low intestinal obstruction as frequently as in high intestinal obstruction if a long enough time is allowed to elapse. Copher and Brooks, on the other hand, were unable to find a decrease in the blood chlorides in animals with a high closed intestinal loop. They believe that the hypochloremia is not due to fixation of the chloride radical but is due to loss of the chlorides in the vomitus as occurs in cases of pyloric obstruction. Because they obtained the characteristic changes following intestinal obstruction in rabbits and monkeys which do not vomit, Haden and Orr believe that the hypochloremia cannot be explained in this manner. In those cases, both clinical and experimental, in which in addition to mechanical obstruction of the gut there is an interference with the blood supply, additional symptoms and signs occur.

Numerous theories have been advanced to explain the symptoms in acute intestinal obstruction. The following are the principal theories.

1 *The intoxication theory.* The intoxication theory presupposes that a toxin is formed within the bowel which is absorbed into the blood stream, producing characteristic symptoms and signs.

a. Toxins resulting from putrefaction of stagnating food within the intestinal tract (Amussat, Bokai, Albeck, Lepine and Mollier, Roger and Garnier, Magnus-Alsleben). Magnus-Alsleben found that following intestinal obstruction ingestion of any food except milk invariably produced a toxin. Cannon, Dragstedt, and Dragstedt found that, in intestinal obstruction, diet had no effect on the bacterial flora. There is relatively little evidence to support the theory that intoxication is the result of absorption of putrefactive substances. Putrefaction is relatively rare in the

upper intestinal tract where the most marked symptoms occur following intestinal obstruction (Ochsner)

b Toxins arising from bacterial invasion of the obstructed gut (Murphy and his co-workers, Clairmont and Ranzi, Cannon, Dragstedt and Dragstedt, Kirschstein, Williams) Murphy and Brooks found that a normal gall bladder could be obstructed without the production of any signs of intoxication. If, however, following obstruction and interference with the nutrition of the gall bladder, bacteria obtained from the intestine were introduced into the gall bladder, symptoms identical with those seen in cases of intestinal obstruction were observed. Fluid from such a gall bladder, when injected into another animal, was also toxic. Dragstedt and his co-workers are of the opinion that it is never possible to sterilize an intestinal loop completely. Relatively recently Williams an English surgeon, advanced the theory that the intoxication seen in intestinal obstruction and ileus associated with peritonitis was similar to and probably dependent upon a bacillus welchii infection. He found that this organism grew best in a neutral or slightly acid medium, and for this reason grows more luxuriantly in the upper than in the lower portions of the intestinal tract. He reports very good clinical results from the use of immune serum in the treatment of such cases. Stabins and Kennedy as well as McIver, White, and Lawson found that following the production of an intestinal obstruction the number of bacillus welchii in the gut increased remarkably. Bower and Clark have obtained very good results clinically from the use of perfringens antitoxin in intestinal obstruction. Morton and Scabins have obtained some benefit following administration of the bacillus welchii antitoxin in experimentally produced intestinal obstruction. On the other hand, Oughterson and Powers obtained no favorable results either from the administration of the antitoxin or from the active immunization of animals against the Welch bacillus. Owings and McIntosh also obtained negative results, employing the bacillus perfringens antitoxin.

c Intoxication resulting from the absorption of normal secretions in an abnormal way

or secretions which have not been toxified (Charrin, Draper and his co-workers, Cybulski and Tarchanoff, McKenna, Sweet, Peet, and Hendrix) Draper believes that most of the intoxications are the result of absorption of the duodenal as well as the pancreatic secretions before they can be detoxified by the ileal cells. As proof of the detoxifying power of the cells of the lower jejunum and ileum he fed animals, with intestinal obstruction, cells derived from the lower jejunum and ileum and found that they lived twice as long as the control animals. Sweet, Peet, and Hendrix found that a closed loop of the ileum did not produce symptoms for periods of time. If, however, pancreatic juice or a piece of pancreas were introduced into the loop, very definite signs of intoxication occurred immediately. Recently Sculberger, Brandes, and Beykirch showed that the presence of both the biliary and pancreatic secretions in the intestinal tract in the presence of intestinal obstruction produced symptoms and signs of intoxication much earlier than either the pancreatic or biliary secretions alone. Much more extensive hepatic lesions were observed in the former group of experiments than in the latter.

d Intoxications produced by the absorption of perverted intestinal secretions (Whipple and Stone and their co-workers, Ellis, Bunting, and Jones) Whipple and Stone and their co-workers believe that in obstruction the normal function of the cells of the duodenum is lost, and that they secrete a substance which is toxic. These observers believe that by destroying the mucosa, as they did by injecting sodium fluoride solution into a closed loop of the intestine, the formation of the toxin may be prevented. Sweet, however, believes that this group of experiments is open to criticism because the destruction of the mucosa does not necessarily interfere with the development of toxins but rather interferes with the absorption of them. Ellis found that if the toxin from a closed loop of intestine were injected intravenously into another animal, a toxin appeared simultaneously in the lumen of the intestinal tract of the second animal. This was also found in animals in which a bilateral adrenalectomy had been

performed Cutting, working in the surgical laboratory at Tulane University, found that adrenalectomized rabbits were unable to withstand the injection of toxins prepared from the gut of obstructed animals as well as control animals. He believes that degenerative changes which are found consistently in the cortex of the adrenal in ileus are responsible, in part at least, for the susceptibility of the animal to the toxin formed within the gut.

c *Bacteriæmia* The theory that the symptoms in intestinal obstruction are due to the absorption of bacteria is at the present time not generally accepted in spite of the fact that Borsceky and Generisch found that in experimentally produced intestinal obstruction *bacillus coli* could be found in the peritoneum or blood or both.

2 *Non toxic causes* a *Dehydration* It is considered by some that the symptoms in intestinal obstruction may be due to other factors besides intoxication. The one theory that has been most frequently accepted is that of dehydration (Hartwell and Hoguet). Dehydration is always present in those cases in which vomiting is a prominent symptom. Hæbler has shown, however, that the symptoms in high intestinal obstruction are not due to dehydration.

b *Blood changes* Because of characteristic blood changes, i. e., decrease in plasma chlorides, increase in the carbon dioxide combining power of the plasma, and an increased urea nitrogen, it is considered by some observers that certain if not all of the symptoms and signs in ileus are dependent upon these changes (Haden and Orr, Gatch, Trussler, and Ayers, Burgess, Walsh and Ivy).

At the present time it is quite generally accepted that, in those cases of intestinal obstruction in which there is some interference with the blood supply to the gut, in addition to dehydration and rather typical blood findings, there is an associated intoxication. Assuming that the symptoms are due to intoxication it is desirable to ascertain the nature of the toxin. Unfortunately, however, it has been impossible, in spite of frequently repeated attempts, to determine the chemical nature of such toxins. The toxin is supposed

by most observers to be the result of an incomplete cleavage of the protein molecule. Murphy and Brooks as well as Whipple, Cook, and Stearns, and Wilkie consider it a proteose. Gley and LeBas and Ellis do not believe that it is a proteose because the former authors were unable to obtain an increase in lymph flow following the introduction of the toxin, and the latter found that the toxin was unaffected by the addition of erepsin and trypsin which normally digest the proteoses and heteroproteoses. Gatch and his co-workers and Dale believe that the substance is a histamine like product. Nesbitt believes that the toxin is neurin. Schoenbauer believes that the toxic substance is trypsin. Dragstedt, Dragstedt and their co-workers felt that it is similar to the toxic amines. An outstanding criticism of the experimental work performed in the isolation of the toxin is that with but two exceptions the toxin has been obtained from the lumen of the intestinal tract and has not been demonstrated within the blood stream. However, Sugito and Scholefield found that if the blood obtained from the portal and mesenteric veins of animals dying from intestinal obstruction were injected into mice, death resulted.

SYMPTOMS AND SIGNS OF ACUTE INTESTINAL OBSTRUCTION

In considering acute intestinal obstruction, it is essential to distinguish between two varieties of ileus, namely, the mechanical and the adynamic, the first being much more frequently found than the latter. However, every surgeon has seen an association of the two types. Doctors Gage, Cutting, and I have been able to demonstrate this association experimentally. In all cases of mechanical obstruction which have existed a relatively long time there is superimposed upon the mechanical obstruction a certain degree of adynamic ileus. One of the earliest symptoms in a mechanical obstruction of the intestine is pain which is characteristically colicky and intermittent. In acute intestinal obstruction obstipation is often lacking and too much dependence should not be placed upon this symptom. In fact not infrequently following the onset of the patient's symptoms one or two evacuations of the bowel occur,

probably due to hyperperistalsis in that portion of the gut below the obstruction. Vomiting may be an early symptom, especially in obstruction high in the intestinal tract. Whether the vomiting is due to a reversed peristalsis, carrying the intestinal contents into the stomach or whether it is due to an increase in gastric secretion associated with complete loss of gastric motility as recently presented by Mueller is not known. Mueller believes that in ileus, especially the adynamic variety, there is a diminution in peristaltic activity, an increase in the gastric and intestinal secretions, and a relaxation of the pyloric and cardiac sphincters, which allows the fluid within the intestinal tract to regurgitate into the stomach. Hyperæmia of the gut wall is supposedly responsible for these changes.

Examination of the abdomen often reveals nothing of significance especially in high intestinal obstruction. In acute intestinal obstruction located relatively low in the intestinal tract there may be considerable distention proximal to the obstruction. The absence of distention, however, should never cause one to hesitate in making a diagnosis of acute intestinal obstruction. Auscultation of the abdomen should never be neglected in a case of suspected intestinal obstruction. In cases of a mechanical obstruction early there is a marked increase in peristaltic activity which can easily be elicited by auscultation. In the adynamic variety, however, in contrast to the normal peristaltic sound the abdomen is "ominously silent" (Deaver).

Although usually not of diagnostic importance the determination of the plasma or whole blood chlorides, the non protein nitrogen of the blood, and the carbon dioxide combining power of the blood are extremely important from the standpoint of prognosis. Recently Scholefield has suggested that a determination of the blood urea may serve as a diagnostic aid. He states that observations made at the Presbyterian Hospital in New York have shown that values up to ten times normal are sometimes found. The usual figures in patients with intestinal obstruction are from four to five times the normal figure. In addition to the increase in the non protein nitrogen of the blood, which is due almost

entirely to the increase in blood urea, there is characteristically in high intestinal obstruction a decrease in the carbon dioxide combining power of the plasma, i.e., an alkalosis.

DIAGNOSIS OF ACUTE INTESTINAL OBSTRUCTION

The diagnosis is made largely on the basis of the symptoms corroborated by the history. In acute high intestinal obstruction a diagnosis should be made before the condition has progressed to such a degree that physical examination is of value. The diagnosis of mechanical ileus is usually not difficult if the condition is only considered by the surgeon. The history of intermittent, colicky abdominal pain is indicative of obstruction to a hollow viscus. If there is a history of previous laparotomy, the possibility of an "adhesions ileus" should be considered. The presence of external hernia, the contents of which cannot be reduced, would facilitate a diagnosis of mechanical ileus. Postoperative ileus may be of the adynamic or of the mechanical variety. The diagnosis of an ileus developing postoperatively is relatively difficult. As repeatedly emphasized by Dr. Ochsner, a patient in whom an intestinal obstruction is suspected should receive nothing by mouth, especially no cathartics.

A valuable diagnostic procedure not sufficiently appreciated is the roentgenography of the abdomen without the administration of contrast substances. First advocated by Schwarz in 1911, this procedure has become popular in the European continental clinics, but, unfortunately, is used relatively infrequently in the United States. Case has, however, been instrumental in introducing this procedure into this country. As is duly appreciated by all surgeons, the administration of a contrast substance to a patient in whom an intestinal obstruction is suspected is not without danger. Not infrequently an incomplete obstruction may be transformed into a complete obstruction as a result of the administration of an opaque meal. In suspected obstructions of the large bowel, it is, however, permissible and at times advisable to examine the large bowel by means of a contrast enema. Roentgenography of the abdomen without

the administration of a contrast substance is, on the other hand, entirely without danger. Because of the increased secretion and diminished absorption from the gut proximal to a mechanical obstruction or in loops of gut in adynamic ileus, there is an accumulation of fluid and gas within the gut. As emphasized by Schwarz, Assmann, Case, and others the presence of abnormally large collections of gas in the small bowel are indicative of some obstruction. More significant, however, than the presence of gas in the intestine is the presence of numerous fluid levels in various parts of the abdomen, when the patient is examined in the erect position. The fluid contents of the intestine assume a dependent position in the loop of gut and are "capped" by gas in the same loop. As this occurs in several loops, such multiple fluid levels can be demonstrated in various parts of the abdomen. Such a roentgenogram is pathognomonic of ileus.

Whenever possible it is essential, before operation, to differentiate between ileus of the obstructive variety and ileus of the adynamic variety, because operative relief of the former is the only therapy which is of any avail, whereas surgical intervention in the latter type is of little value. As early as 1922, Wagner suggested that lumbar anaesthesia might be used as a diagnostic procedure in ileus for differentiating the adynamic from the obstructive type, because of the beneficial results which he had obtained following the use of lumbar anaesthesia in the treatment of ileus. Recently Willard Bartlett, Jr., and W. J. Mayo have again suggested such a procedure as a diagnostic aid. The employment of splanchnic block either as a lumbar analgesia or as a spinal analgesia is not reliable in differential diagnosis as is shown by Duval's series of cases. Duval found that an evacuation of the intestines was produced in 16 per cent of the cases of mechanical ileus in which lumbar analgesia had been performed.

PROGNOSIS

The prognosis in intestinal obstruction depends upon several factors. Of most importance is the time of operation, the earlier the operation, the better the prognosis. As aptly

stated by Van Beuren, "the longer a patient with intestinal obstruction lives before operation, the sooner he dies afterward." Miller states that the mortality rises approximately 1 per cent for each hour of procrastination. Van Beuren, in experimentally produced intestinal obstruction, found that within 48 hours 25 per cent of the animals showed intestinal damage, whereas after 48 hours 60 per cent showed damage. He also found that 75 per cent of the animals with obstructions of 48 hours' duration recovered following the relief of obstruction, whereas 75 per cent of the animals in which an obstruction had been present for 72 hours died after such operation. In a series of 343 cases of intestinal obstruction reported by Miller, the mortality rate when the patient was subjected to operation within 12 hours after the onset of symptoms was 29.4 per cent, within 24 hours, 52.9 per cent, within 36 hours, 50 per cent, within 48 hours, 59.6 per cent, within 72 hours, 63.4 per cent, within 96 hours, 72.8 per cent, and over 96 hours, 84 per cent. In a series of 83 cases of intestinal obstruction reported by Brill the mortality rate when operation was performed within 72 hours of onset of symptoms was nil, when performed between 12 and 24 hours, 12.5 per cent, between 24 and 48 hours, 61.1 per cent.

The increase in mortality as the case progresses is undoubtedly due to an interference with the blood supply of the gut superimposed upon the mechanical obstruction. This is dependent upon the increase in the intra-intestinal pressure above the point of obstruction. Owings, McIntosh, Stone, and Weinberg and Morton have shown that interference with the blood supply occurs more frequently in the upper part of the intestinal tract than in the lower part because of the more rapid increase in intra-intestinal pressure. In considering the prognosis in intestinal obstruction, it is necessary to distinguish between simple mechanical obstruction, in which there is no interference with the blood supply of the gut and one in which this interference has become established. It is quite generally accepted that in the former type of case signs and symptoms of intoxication never occur. As already mentioned, changes in the

blood may occur, Brooks, Schumacher, and Wattenberg have shown experimentally that a closed intestinal loop could be tolerated by an animal for 21 days, provided there was no strangulation of the blood supply or marked distention of the gut, even though the loop supposedly contained eight hundred times the lethal dose of toxin.

It is also necessary to distinguish in ileus between cases of the mechanical variety and cases of the adynamic variety, always remembering that the two may be combined. The prognosis in the latter type is much worse than in the former. The most frequent cause of mechanical obstruction is hernia, followed in frequency by adhesions. In Miller's series of 343 cases, hernia was the cause of obstruction in 28 per cent, adhesions in 19.8 per cent, intussusception in 12.2 per cent, volvulus in 9.9 per cent, bands, 8.7, carcinoma, 4.9, thrombosis, 2.

The causes of the adynamic type of ileus are varied. In all probability this type of ileus is the result of an overstimulation of the inhibitory nerves (splanchnics) to the intestines. Peritonitis, lesions within the central or sympathetic nervous system, certain types of abdominal trauma and nerve lesions, certain types of toxemias are frequent causes of the adynamic type of ileus. As early as 1907 Cannon and Murphy showed that adynamic ileus experimentally produced by crushing the testicles could be prevented by cutting the splanchnic nerves. Markowitch and Campbell and Domenech have shown that spinal analgesia is effective in relieving adynamic ileus. In our laboratory, Gage, Cutting, and I have been able to relieve, experimentally, by splanchnic block, physiological, chemical, and adynamic ileus superimposed upon mechanical ileus.

Peritonitis either as a cause of the ileus or as a result of extension of infection from the intestine is of importance as regards prognosis because the prognosis is much worse in the presence of such a complication. I wish here to pay tribute again to Dr. Ochsner who did so much toward placing the prevention and treatment of peritonitis on a sound and rational basis. He emphasized the principle that all food and especially cathartics should

be withheld in cases of suspected intestinal obstruction. Schoenbauer has shown that the peritoneal exudate in intestinal obstruction is toxic when given intravenously.

TREATMENT

As stressed in the discussion of prognosis, early operative intervention is of the greatest importance in intestinal obstruction. If a mechanical obstruction can be relieved before distention has progressed to such a degree that interference with the blood supply to the gut has occurred, the mortality should be practically nil. In those patients in whom dehydration is a marked factor, fluid should be administered either subcutaneously or intravenously. Because of the hypochlorama, chlorides in the form of sodium chloride should be administered. Orr and Haden recommend the intravenous administration of 500 cubic centimeters of a 5 per cent sodium chloride solution preoperatively. Eliason prefers 5 per cent glucose in normal salt solution, whereas McVicar and Weir employ 10 per cent glucose in 1 per cent sodium chloride solution. The latter authors believe the hypertonic glucose solution is of distinct value in promoting diuresis in individuals in whom there is more or less nitrogen retention.

As rigidly practiced by Dr. Ochsner in every case of intestinal obstruction gastric lavage should be performed, especially immediately before operation. "As harmful as is the giving of food and cathartics in these cases, so equally beneficial is the opposite form of treatment by means of repeated gastric lavage, which often removes a considerable amount of poisonous material from the alimentary canal and permits the intestines and the stomach to contract. It also tends to prevent the occurrence of aspiration pneumonia caused by inspiration of fetid intestinal contents regurgitated during the operation" (10). It is also well to leave the tube in place in order to prevent vomiting and possible aspiration while the patient is on the operating table. Because of the danger of vomiting and possible aspiration of the vomitus and because of the possibility of respiratory embarrassment due to elevation of the diaphragm by gas distended intestines,

an inhalation anæsthetic should not be employed. Either a splanchnic analgesia, according to the technique of Kappis, or a spinal analgesia is to be preferred.

The operative procedure varies with the lesion encountered. It is imperative that the obstruction be relieved in some manner. Frequently no attempt should be made to extirpate the obstructing lesion because resection may be more than the patient can survive. There is probably no condition which requires more gentleness than acute intestinal obstruction. Bunnell states "Every manipulation is a shove nearer the grave." In such a case the operative procedure of simple drainage of the intestine above the obstruction is the method of choice. It is far better to have a living patient who requires a secondary operation than a dead one in whom the operation was completed. Heidenhain advocated an enterostomy in acute ileus as early as 1897. Lennander because of the severe toxemia present in high intestinal obstruction, believed that the toxic products were absorbed from the upper jejunum and advocated jejunostomy in intestinal obstruction. Lee and Downs advise a jejunostomy performed as high as possible. Haden and Orr found, experimentally, that animals in which a jejunostomy was performed at the same time a high intestinal obstruction was produced lived a shorter period of time than those animals in which no jejunostomy was performed. Recently these authors have reported the successful use of enterostomy performed in the ileum in cases of peritonitis. Experimentally, they were able to show that simple enterostomy did not prolong the life of an animal, but that enterostomy plus the addition of 1 per cent sodium chloride solution, hypodermically, tripled the life of the animal. They state "When any doubt exists concerning the value of enterostomy, it should be done." Scholefield reports that from the years 1916 to 1920 in 4 cases of paralytic ileus following appendicitis in the Presbyterian Hospital in New York, an ileostomy was performed with a 75 per cent mortality, and in 8 cases seen in this hospital from 1916 to 1920 a jejunostomy was performed with a mortality of 37.5 per cent. This author believes

that the failure of low enterostomies to drain the bowel adequately is due to the length of the intestine which becomes paralyzed, forming a series of obstructed loops above the point of drainage. He believes that a high ileostomy or jejunostomy provides an escape for the secretions of the duodenum or upper ileum. Van Beuren studied the cases of acute ileus operated upon during the past 12 years in the Presbyterian Hospital in New York. The time was divided into three periods of 4 years each. In Van Beuren's series of cases it was shown that the diagnosis of acute ileus was made more frequently than previously as evidenced by the increased number of cases in the later periods. The mortality rate was materially reduced during the last 8 years, especially during the last 4 years. Enterostomy was used more frequently than previously—one-third of the cases in the first period, one-half in the second period, and three-fourths in the third period. There was a greater reduction in the average mortality of cases treated by enterostomy than those which were not so treated, 38 per cent lower in the enterostomy group, 29 per cent lower in the non-enterostomy group. The number of late cases seen in the last 4 years increased over those seen in the previous 4 years. However, there was a decrease in mortality of 13 per cent. Van Beuren states "Enterostomy done at the right time in the right way is the most effective means we have at present to relieve and prevent intestinal overdistention and anæmia."

Following the relief of obstruction either by enterostomy or relief of the obstructive lesion, the postoperative treatment of the patient is extremely important. Until normal peristalsis is established everything should be withheld by mouth, a procedure which was strictly emphasized by Dr. Ochsner. The patient should receive every 24 hours either subcutaneously, intravenously, or rectally, from 3 to 5 liters of fluid. The fluid is administered as 1 per cent saline or 5 per cent glucose solution intravenously, normal saline hypodermically, and either physiological saline solution, 2 per cent glucose solution, or tap water per rectum. Frequent examinations of the blood should be made to determine the presence

or absence of a hypochloræmia as well as a determination of the carbon dioxide combining power of the plasma. In severe cases of alkalosis Gage has successfully employed acid sodium phosphate intravenously in a 1 per cent solution. Frequent gastric lavage is imperative. As practiced very successfully by Dr Ochsner, the application of heat to the abdomen by means of an electric light tent is of immense value. Mueller believes that in "paralytic ileus" there is a decrease in movement of the intestinal tract and an associated increase in secretion. Because of the viscerosplanchnic balance he believes that the application of heat to the abdomen by producing a dilatation of the peripheral vessels causes a contraction of the splanchnic vessels. In so doing the secretion is diminished and motility increased. As an agent to stimulate peristalsis the application of heat to the abdomen has in our hands been the most valuable one which we possess.

The treatment of adynamic ileus either as a primary lesion or as a lesion superimposed upon a mechanical ileus which has been relieved is the same as that of the mechanical variety, except possibly operative interference. It is in this type of ileus that splanchnic block is of greatest value either as a spinal or splanchnic analgesia. Recently, Gage, Cutting, and I compared the effects of both spinal and splanchnic analgesia on normal animals and on those with intestinal obstruction, employing not only novocain but also nicotine, as recommended by Rosenstein and Koehler, as the anæsthetic substance in the splanchnic area and novocain in the dural sac. Contrary to the apparently brilliant and highly satisfactory results obtained both clinically and experimentally by Rosenstein and Koehler by the injection of nicotine solution into the splanchnic area we found that nicotine employed in this manner is a dangerous drug because of the production of very marked increases in blood pressure. The effect on the gut was also minimal. Comparing the results obtained following the introduction of novocain solution into the splanchnic area and into the dural sac, we found that in the former instances the effect on the gut was more marked than in the latter. In both types of

cases there was a decrease in blood pressure, which, however, was greater following spinal analgesia than following splanchnic analgesia. Clinically, splanchnic block has been successful in relieving adynamic ileus in a number of cases. We feel from our experimental work that the induction of splanchnic analgesia is to be preferred to the induction of spinal analgesia.

There has been considerable controversy concerning the efficacy of different drugs in the treatment of adynamic ileus. The drugs which are most frequently employed are some form of pituitary extract, physostigmine or eserine, peristaltin, choline or acetyl choline, and some few others. Blair Bell was the first to employ a pituitary extract in the treatment of ileus. Since his original report in 1911 numerous reports have been made, many of which have been favorable, others which have been unfavorable. It might be said from a review of the literature that the most favorable results are reported by clinicians, the least favorable results are reported by scientists whose observations have been undoubtedly more carefully made and in a more critical manner. In our laboratory Drs Cutting, Gage, and I have found that, with but few exceptions pituitary extracts, both pituitrin and pitocin, exert a depressing effect on both the normal and the obstructed gut, as evidenced by cessation of intestinal movement and loss of intestinal tone. Exceptionally an increase in intestinal activity was noted. Extracts of the calabar bean were first used by veterinarians in the treatment of obstruction in animals. Active principles of this bean are used in medicine today in the form of physostigmine or eserine. There are a number of clinical reports advising the use of this alkaloid. Owings and McIntosh showed that eserine was much more efficient in increasing the intra intestinal pressure than was pituitrin, the latter almost invariably exhibiting a relaxing effect on the gut. Martzloff in a series of patients studied on the gynecological service at the Johns Hopkins Hospital who received, after operation, eserine salicylate, grain 1/100, strychnine sulphate, grain 1/40, hypodermically, every 4 hours for 8 doses, found that eserine and strychnine

given in these doses exerted no valuable prophylactic effect on the gut. Our own results indicate, however, that eserine in fairly large doses is occasionally capable not only of increasing the intra-intestinal pressure by increasing the intestinal tone, but also of increasing intestinal movement. Peristalsis in our hands exerted an inconstant effect on both normal and obstructed intestines. Choline has been used rather extensively, especially by German observers in the treatment of ileus. Because it supposedly has a hormone inducing intestinal activity, theoretically it should be an ideal substance for this purpose. However, in our hands in the experimental laboratory this substance is of no value either in increasing the tone or increasing the intestinal movement. Hughson and Scarff found that intravenous administration of a hypertonic sodium chloride solution produced violent peristalsis in animals. This observation was corroborated by Ross and by us. Numerous clinical reports have been made concerning the use of this substance.

CONCLUSIONS

1 In all cases of ileus there are varying degrees of vascular occlusion, in the high obstructions the vascular disturbance may be intramural.

2 The prognosis in ileus depends upon the length of time which has elapsed since the onset, the location of the obstruction, and the previous therapy. Blood chemistry determinations are of value for prognosis and proper treatment.

3 Symptoms and signs of ileus are usually characteristic. Plain roentgenograms of the abdomen with the patient in the upright position without the administration of contrast media are of value in diagnosing ileus.

4 Early operation or relief of obstruction in ileus is imperative.

5 Enterostomy is of value in both the adynamic and obstructive types of ileus, provided enterostomy alone is not employed.

6 Splanchnic block, preferably by means of a splanchnic analgesia (Kappis) is of distinct value in adynamic ileus.

7 Drugs are of little or no value in the treatment of ileus.

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THE EFFECT OF INJECTIONS OF FEMALE SEX HORMONE (ŒSTRIN) ON CONCEPTION¹ AND PREGNANCY IN THE GUINEA PIG²G LOMBARD KELLY, M.D. AUGUSTA, GEORGIA
Professor of Anatomy Medical Department University of Georgia

THE relationship between the length of the Œstrous cycles and the gestation periods of various mammals, including man, has long been noted. That is, the gestation period is some multiple of the cycle. For instance, in the guinea pig, the gestation period is about four times the length of the cycle and in the human ten times.

It is also a matter of common knowledge that abortions are especially apt to occur at the end of the first period in the pregnancy, less so at the second, and so on. It has been generally thought and recently proved by Corner and Allen (1, 3, 4) that the corpus luteum hormone has an essential part to play in the nidation of the ovum. Probably it plays an equally important part also in the preservation of the life of the embryo for some time after nidation, though its removal in early pregnancy without death of the young has been reported by L. Loeb, in the guinea pig. On the other hand, Parkes and Bellerby in the mouse and Corner (3) in the rabbit find that removal of the corpora lutea causes premature termination of the pregnancy.

Is there a balance between the corpus luteum hormone and the hormone that produces Œstrus? It has been conclusively shown that the corpus luteum has an effect inhibitory to Œstrus. In the guinea pig, Papanicolaou demonstrated definite postponement of the onset of Œstrus by injections of corpus luteum hormone. This work has been corroborated in the rat by Pereya, and in the guinea pig by Macht et al.

Thus, two clear cut functions of the corpus luteum were demonstrated by the experimental method: first, its importance in the early life of the ovum, and, second, its ability to offset the Œstrus producing hormone and prevent heat.

On the other hand, it had been shown that the female sex hormone was the active agent in producing Œstrus and that injections of it would throw even castrated animals into heat.

It was also known that the corpus luteum undergoes degenerative changes later in pregnancy. Textbooks of embryology have long stated this for the human, and changes have been demonstrated in the rat by Long and Evans, using the vital staining method.

The writer has shown that injections of serum from pregnant women delay the onset of Œstrus in guinea pigs, indicating an excess of corpus luteum in women's blood during gestation.

This conception of antithetic actions of the female sex hormone and the corpus luteum hormone led to the hypothesis that labor may result from the newly gained ascendancy of the female sex hormone over that of the degenerating corpus luteum, and pregnancy thus be terminated. Rucker writes of the "relation of the ovarian hormone to the onset of labor" and Glismann of "recurrent abortion (prevention with corpus luteum extract)".

The fact that certain animals go into Œstrus, copulate, and ovulate immediately after parturition, strengthened this conception, as it was easy to consider that the accumulating Œstrin necessary for the heat period gradually came to exceed the corpus luteum and, having gained the ascendancy, rendered the continuation of pregnancy impossible.

About the time this theory was formulated by the writer, confirmatory evidence was forthcoming. Two papers were published, the contents of which were in line with this thought. Margaret Smith reported that she had been able by injecting female sex hormone into pregnant white rats to terminate the pregnancy if it had not exceeded 5 days. She was also able to prevent conception. The largest dose she administered was 80 rat units of hormone.

Parkes and Bellerby using white mice, reported that they were able to prevent conception and to interrupt pregnancy at any stage, with comparatively small doses (1 to 5

¹By conception is meant not fertilization but the act of becoming pregnant (nidation of the ovum).

²Contribution No. 6, Series B from the Department of Anatomy Medical Department University of Georgia. Read before the American Association of Anatomists, Charlottesville, Virginia, April 19, 1930. This work has been aided by a grant from the Committee for Research in Sex Problems, National Research Council.

TABLE I

| Animal | Cop date | Time | Peptone c cm | Injection | Total c cm | Result |
|--------|----------|----------|--------------|-----------|------------|-------------|
| 1149 | 6-5-29 | 9 10 a m | 0.5 | 6 | 3 | Conceived |
| 1175 | 6-5-29 | 4 50 p m | 0.5 | 6 | 3 | Conceived |
| 1057 | 6-5-29 | 5 10 p m | 0.5 | 6 | 3 | (Estrus 22) |

TABLE II

| Animal | Cop date | Pregnant days | Peptone c cm | Injection | Total c cm | Pregnancy |
|--------|----------|---------------|--------------|-----------|------------|------------|
| 1253 | 2-22-29 | 25 | 2.5 | 9 | 22% | Unaffected |
| 1154 | 2-28-29 | 40 | 5 | 0 | 45 | Unaffected |
| 1049 | 3-22-29 | 42 | 2 | 22 | 22 | Unaffected |
| 1127 | 5-28-29 | 35 | 1 | 22 | 22 | Unaffected |
| 1139 | 4-3-29 | 28 | 2 | 12 | 22 | Unaffected |

*These two animals were subsequently used in another experiment

mouse units), though the dosage needed in the latter part of pregnancy was about twice as large as in the first half

With the exception of a short report by Loeb, apparently no further investigation of this problem by this method has been reported. The experiments reported by Loeb are so indefinite and the results so inadequate, that little comment is needed. No dosage is reported and no interruptions of pregnancy. He also states that the vagina did not open during injections and this would indicate that his dosage was too small.

Other reports that have a bearing on this question have appeared since the work of Smith and of Parkes and Bellerby and will be referred to later.

MATERIAL AND METHOD

The animals used in this investigation have been fully mature female guinea pigs, fed on a diet adequate for reproductive purposes, and housed by pairs in well kept cages. Injections were made in several groups, as follows: (a) administration of oestrin just after copulation, (b) administration of peptone solution to controls just after copulation, (c) oestrin to pregnant animals at various stages (from 2 to 8 weeks), (d) peptone solution to pregnant controls, and (e) oestrin to males and non pregnant females for a study of its toxicity.

The hormone used was furnished by two biological supply houses and had been assayed

TABLE III

| Animal | Cop date | Time | Rat units | Injections | Units total | Pregnancy | Return to heat |
|--------|----------|-----------|-----------|------------|-------------|-----------|----------------|
| 1054 | 4 26 10 | 20 55 a m | 20 | 6 | 120 | Yes | 5-23-29 |
| 1245 | 5 23-29 | 12 55 p m | 10 | 6 | 120 | Yes | 5 24-29 |
| 1058 | 5 20-29 | 9 20 a m | 20 | 6 | 120 | Yes | 5-30-29 |
| 1104 | 6-22-29 | 20 25 a m | 20 | 6 | 120 | Yes | 6-14-29 |
| 1151 | 6-24-29 | 20 25 a m | 20 | 6 | 120 | Yes | 6-24-29 |
| 1022 | 6-14-29 | 10 32 a m | 10 | 6 | 120 | Yes | 6-25-29 |
| 1170 | 12-14-29 | 4 00 p m | 10 | 6 | 60 | Yes | 12-26-29 |
| 1266 | 12-25-29 | 11 00 a m | 10 | 6 | 60 | Yes | 1 5 30 |
| 1028 | 2 14 30 | | 5 | 3 | 15 | Yes | 1 15 30 |
| 1126 | 3- 2-30 | | 5 | 3 | 15 | Yes | 3 17 30 |
| 1199 | 2-20-30 | | 5 | 5 | 25 | Yes | 3- 7 30 |
| 1205 | 5 20 30 | | 5 | 1 | 10 | Yes | 4- 3-30 |
| 1275 | 3 20-30 | | 5 | 1 | 10 | Yes | 4- 5-30 |
| 1260 | 5 24-30 | | 5 | 1 | 10 | Yes | 4- 8-30 |
| 1193 | 5-24-30 | | 5 | 2 | 10 | Yes | 4- 8-30 |
| 1251 | 5-25 30 | | 5 | 2 | 10 | Yes | 4 10-30 |

by the Allen and Doisy method¹. It was found fully potent. On account of the large doses used in late pregnancy, we were fortunate in obtaining also a large supply of hormone in oil that assayed 500 rat units to the cubic centimeter. This product was diluted with a small quantity of glycerine and injected subcutaneously in the back region. Since a fifth of a cubic centimeter contained 100 rat units (the largest single dose administered), the volume injected was usually small.

Injections were as a rule given over a period of 6 days in equal doses, though some were given for only 3 days, or less, and others as long as 23 days. In the later stages of pregnancy, very large doses of oestrin were used because Parkes and Bellerby found that in the mouse about twice as much hormone was necessary to interrupt pregnancy then as in the first stages.

A number of pregnant animals used for controls received injections of one per cent peptone solution over periods varying from 9 to 12 days, in amounts varying from 1 to 5 cubic centimeters per day. Controls used in

¹For further information concerning the Squibb product see J. Am. Med. Ass. 1029 (1929) 2078. This account states it is free of protein and cholesterol.

²From Dr. J. F. Anderson of E. R. Squibb & Sons.

TABLE IV

| Animal | Pregnant days | Rat units | Injections | Units total | Aborted | Delivered | Died |
|--------|---------------|-----------|------------|-------------|---------|-----------|------|
| 1273 | 17 | 25 | 6 | 150 | Yes | No | No |
| 1274 | 17 | 25 | 6 | 150 | Yes | No | No |
| 1251 | 12 | 25 | 6 | 150 | Yes | No | No |
| 1254 | 12 | 12 5 | 6 | 75 | Yes | No | No |
| 1202 | 15 | 12 5 | 6 | 75 | Yes | No | No |
| 1267 | 17 | 12 5 | 6 | 75 | No | Yes | No |
| 1256 | 14 | 12 5 | 6 | 75 | Yes | No | No |
| 1258 | 13 | 12 5 | 6 | 75 | Yes | No | No |

the test for prevention of conception received six daily injections of 0.5 cubic centimeter each

RESULTS

Prevention of conception controls This group of animals was the smallest used in any test. Three were injected with a half cubic centimeter of one per cent peptone solution on 6 successive days. Two of the animals conceived and one did not (Table I).

Pregnant controls Five animals comprised this group. They were given doses of one per cent peptone solution varying from 1 to 5 cubic centimeters over periods ranging from 9 to 12 days. The total quantity injected varied from 11 to 45 cubic centimeters. None of these animals had the course of pregnancy affected by the treatment (Table II).

Prevention of conception In this series 16 animals were used and the dosage ranged downward from a total of 120 rat units to as low as 10 units, given in equal amounts over a 6 day period. An effort was made to ascertain the smallest dose that would prevent conception. Of 6 animals that received 120 units, none conceived. Of 2 that received a total of 60 units, neither conceived. Of 3 animals that received a total of 15 units, none conceived, and of 5 that received a total of 10 units, none conceived. It is noteworthy that the animals that received the larger doses of oestrin had short intervals between heat periods (with one exception), only 10 to 12 days, whereas the others had normal cycles (Table III).

Copulation was checked in each case by the finding of fresh sperm in vaginal smears.

TABLE V

| Animal | Pregnant days | Rat units | Injections | Units total | Aborted | Delivered | Died |
|--------|---------------|-----------|------------|-------------|---------|-----------|------|
| 1120 | 32 | 50 | 6 | 300 | Yes | No | Yes |
| 1265 | 28 | 50 | 6 | 300 | No | No | Yes |
| 1250 | 28 | 50 | 6 | 300 | No | No | Yes |
| 1131 | 28 | 50 | 6 | 300 | Yes | No | No |
| 1012 | 31 | 50 | 6 | 300 | No | No | Yes |
| 1263 | 29 | 50 | 6 | 300 | Yes | No | No |
| 1264 | 29 | 50 | 6 | 300 | Yes | No | No |
| 1255 | 31 | 50 | 6 | 300 | Yes | No | Yes |
| 1125 | 27 | 50 | 6 | 300 | No | No | Yes |
| 1218 | 30 | 50 | 6 | 300 | Yes | No | No |
| 1020 | 30 | 50 | 14 | 700 | No | No | Yes |
| 1041 | 28 | 50 | 14 | 700 | Yes | No | Yes |

Animals about two weeks pregnant In this group of 8 animals, the duration of pregnancy ranged from 12 to 17 days. The total dosage of hormone varied in each case from 75 to 150 rat units, given in the usual manner (6 equal injections). All 3 of the animals that received 150 rat units aborted. Of the 5 remaining animals, receiving 75 units each, 4 aborted, and 1 was delivered at term. None of these animals died (Table IV).

Pregnancy was corroborated by the predominance of blood in the vaginal smears at the time of abortion. Moreover, in a group of this size, not less than three-fourths would have conceived after copulation.

Animals about four weeks pregnant These animals were divided into two groups, one receiving large doses of hormone and one receiving decreasing doses, as an effort was being made to ascertain the smallest average effective dose.

In the first group 12 animals were used. The duration of pregnancy varied from 27 to 32 days. Ten animals received a total dosage of 300 rat units. Of these, 6 aborted and 4 died with retained fetuses. In this whole group 7 animals aborted and of these, 3 died. Eight of the 12 died, 5 with retained, macerated fetuses (Table V).

In the second group of this series the smaller dosage did not take such a heavy maternal toll. Seven animals were used. Three received 150 units, two 120 units, and two 90

TABLE VI

| Animal | Pregnant days | Rat units | Injections | Units total | Aborted | Delivered | Died |
|--------|---------------|-----------|------------|-------------|---------|-----------|------|
| 1261 | 28 | 25 | 6 | 150 | Yes | No | No |
| 1252 | 28 | 25 | 6 | 150 | Yes | No | No |
| 1266 | 28 | 25 | 6 | 150 | Yes | No | No |
| 1057 | 26 | 15 | 6 | 90 | Yes | No | No |
| 1231 | 26 | 20 | 6 | 120 | Yes | No | No |
| 1256 | 27 | 20 | 6 | 120 | Yes | No | No |
| 1258 | 27 | 15 | 6 | 90 | No | Yes | No |

TABLE VII

| Animal | Pregnant days | Rat units | Injections | Units total | Aborted | Delivered | Died |
|--------|---------------|-----------|------------|-------------|---------|-----------|------|
| 1253 | 44 | 100 | 9 | 900 | No | No | Yes |
| 1254 | 50 | 50 | 23 | 1150 | No | No | Yes |
| 1218 | 49 | 50 | 13 | 650 | Yes | No | No |
| 1051 | 42 | 50 | 15 | 750 | No | No | Yes |
| 1227 | 43 | 100 | 6 | 600 | No | No | Yes |
| 1210 | 42 | 100 | 6 | 600 | No | No | Yes |
| 1237 | 42 | 100 | 6 | 600 | Yes | No | No |
| 1272 | 42 | 100 | 6 | 600 | No | No | Yes |
| 1249 | 42 | 100 | 6 | 600 | No | No | Yes |
| 1247 | 43 | 100 | 6 | 600 | No | No | Yes |
| 1260 | 44 | 100 | 6 | 600 | No | No | Yes |
| 1263 | 43 | 100 | 6 | 600 | No | No | Yes |

units each. Of these, 6 aborted and 1 went on to normal delivery. This last animal was one of the two that received only 90 rat units (Table VI).

Animals six to eight weeks pregnant. This series of animals was likewise divided into two groups, one receiving quite large doses and the other smaller doses of the hormone.

In the first group there were 12 animals, pregnant from 42 to 56 days. These animals received a total dosage each of from 600 to 1150 rat units. Only 2 miscarried. The 10 remaining died with retained, macerated fetuses (Table VII).

In the second group 5 animals pregnant from 42 to 46 days received from 300 to 480 rat units and all of these died with retained, macerated fetuses (Table VIII).

Toxicity of hormone in males and non pregnant females. Since quite a large per-

TABLE VIII

| Animal | Pregnant days | Rat units | Injections | Units total | Aborted | Delivered | Died |
|--------|---------------|-----------|------------|-------------|---------|-----------|------|
| 1003 | 46 | 80 | 6 | 480 | No | No | Yes |
| 1020 | 44 | 80 | 6 | 480 | No | No | Yes |
| 1032 | 44 | 60 | 6 | 360 | No | No | Yes |
| 1246 | 41 | 60 | 6 | 360 | No | No | Yes |
| 1059 | 42 | 50 | 6 | 300 | No | No | Yes |

TABLE IX

| Animal | Rat units | Injections | Units total | Date injected | Date death |
|--------|-----------|------------|-------------|-----------------|------------|
| 1273 | 100 | 3 | 300 | 1919 11-7-19 | 12-10 |
| 1276 | 100 | 6 | 600 | 12-12-19 | Lived |
| 1282 | 100 | 3 | 300 | 12-9-19 | 12-11 |
| 1283 | 100 | 3 | 300 | 12-9-19 | 12-11 |
| 1040 | 100 | 1 | 100 | 12-15 | 12-15 |
| 1215 | 100 | 6 | 600 | 12-15-19 | Lived |
| 1207 | 100 | 6 | 600 | 12-15-19 | 12-16 |
| 1245 | 100 | 6 | 600 | 12-15-19 | 12-27 |
| 1231 | 100 | 2 | 200 | 12-9-19 | 12-11 |
| 1256 | 100 | 2 | 200 | 12-9-19 | 12-11 |
| 1047 | 100 | 6 | 600 | 12-15-19 | 12-19 |

TABLE X

| Animal | Rat units | Injections | Total units | Date injected | Result |
|--------|-----------|------------|-------------|-----------------|------------|
| 1016 | 100 | 6 | 600 | 1919 1-20-19 | Unaffected |
| 1237 | 100 | 6 | 600 | 1-20-19 | Unaffected |
| 1238 | 100 | 6 | 600 | 1-20-19 | Unaffected |
| 1001 | 100 | 6 | 600 | 1-20-19 | Unaffected |
| 1007 | 100 | 6 | 600 | 1-20-19 | Unaffected |
| 1204 | 100 | 6 | 600 | 1-20-19 | Unaffected |

centage of the animals in advanced pregnancy died following injections of the hormone, an effort was made to ascertain if the hormone itself was toxic in large doses. The results of this experiment are somewhat conflicting but the fact stands out, nevertheless, that these animals can in many cases receive as much as 600 rat units of the female sex hormone with no ill effects.

In all, 17 animals were injected and these were treated in two groups of 11 and 6. (On account of the lethal effects in the first series, a second was undertaken.)



Fig 1 Normal non pregnant guinea pig uterus



Fig 2 Non pregnant guinea pig uterus after six 100 rat unit injections. Some enlargement and increased vascularity, but no destruction as seen in Figure 3 with half the dose

Of the first 11 animals, 8 were females and 3 were males. The dosage varied from 100 to 600 rat units. One animal died after one injection of 100 units. Two died after two injections of 100 units each. In all, 9 of this group died. The 2 animals that survived received a total of 600 units each. This series of animals consisted of the smallest that were used, many being only half the size of the test animals reported on above (Table IX).

As the results of the foregoing were rather contradictory and as many of the animals used were quite small, another test, using fully grown animals, was decided upon. There were 3 males and 3 females in the group. Each animal received six 100 unit doses in 6 days. None of these animals died or became ill (Table X).

Gross and microscopic study of uterus, placenta, and ovaries. The most marked change in the reproductive organs after injections of female sex hormone was always a vascular one. The increased vascularity was usually easy to observe in the gross and was always prominent in microscopic preparations.

There was, however, a wide variation in response among different animals. In some non-pregnant animals doses amounting to 600 rat units would produce no marked change in the uterus or ovaries. In others the same dose or even a smaller amount would result in almost complete obliteration of the uterine glands and cause the greatest hyperæmia. (Possibly the stage of the cycle when the injections were made had some effect. Figs 1, 2, and 3.)

In pregnant animals the uterus was already hyperæmic and comparisons were difficult. Therefore sections were made through uterus and placenta at their point of union in normal (uninjected) and injected animals. In this way a marked difference was found between the two. In the normal the chorionic villi had the usual appearance, whereas in the test animals the villi were pressed upon by large lakes of blood and were damaged in some cases almost to the point of destruction (Figs 5, 6, 7, and 8).



Fig 3 Non pregnant guinea pig uterus after six 50 rat unit injections. Marked vascularity and destruction of uterine glands



Fig 4 Guinea pig ovary from pregnant animal after six 100 rat unit injections of estrin showing corpus luteum apparently unaffected also many atretic follicles

The ovaries sometimes presented quite a number of large follicles and at times only one large cyst, at others they appeared almost normal. In microscopic preparations there was a greater vascularity present and probably on the whole a larger number of follicles, but the variations in the ovaries were not so marked as in the uterus and placenta.

The corpora lutea of pregnancy persisted apparently unchanged, even after numerous injections of large doses of the female sex hormone (Fig 4).

There was no evidence of ovulation and formation of fresh corpora lutea.

It was the rule for the vagina of the pregnant animals to open during the course of the injections, but the vaginal smears were not usually typical of estrus. The females were isolated and no attempts were made to breed them.

Always at autopsy, the junction of the uterus and placenta, when the latter was

pulled away, had a necrotic appearance. This could have been due to the fact that the fetuses had usually been dead for several days before the death of the mother.

SUMMARY OF RESULTS OF EXPERIMENTS AND CLINICAL APPLICATION

It is interesting to observe the ease with which conception can be prevented by injections of female sex hormone just after copulation. Presumably, at this time, the corpus luteum has not developed far enough to furnish a quantity of hormone sufficient to counteract the injected estrin. The necessity of the corpus luteum hormone for nidation of the ovum has been nicely demonstrated in the rabbit by the recent experiments of Corner and Allen (1, 3, 4), and had long been so considered (Fraenkel, Ancel and Bouin, and others).

It is also quite striking with what ease early pregnancy can be interrupted by this method and how the dosage must be increased for



Fig 5 Chorionic villi as seen in normal pregnant control guinea pig

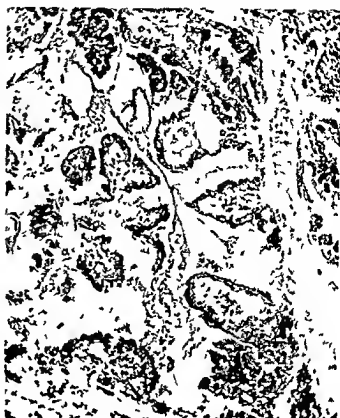


Fig 6 Chorionic villi after six 100 rat unit injections of oestrin. Note shrinkage and fragmentation

later stages. This result is in full accord with the findings of Parkes and Bellerby.

The abortions cannot be considered the result of handling or of the treatment with a foreign substance. The control animals received from a 50 to a 100 per cent more injections of peptone solution and volumes far greater than were used in the test animals (from 11 to 45 cubic centimeters) and yet none had their pregnancy interrupted.

A difficult problem is faced when we ask what was the cause of death of the fetuses and the mothers in the latter half of pregnancy. The microscopic study of the chorionic villi suggests that changes in the placenta cause the death of the young. The atrophy of the villi and the great blood sinuses that form around them would seem to bear some relation to this result.

The question arises why do not the mothers miscarry after the young have died *in utero*? Their macerated condition at autopsy shows that they die days before the mother.

It is a well known fact that the pubic symphysis of the guinea pig dilates an inch or



Fig 7 Same as Figure 6, showing large area filled with blood



Fig 8 Chorionic villi after six 100 rat unit injections of oestrin showing extreme degree of destruction with enormous blood invasion

more at the time of parturition (or just before it) and necessarily so, because the normal pelvic diameters are so much smaller than those of the fetal head at or near term. It should be borne in mind that the gestation period in this animal is unusually long for one of its size (9 weeks) and that the young are born in a well developed state and run around and eat the day they are born (Figs 9 and 10).

This dilatation was recognized a long time ago and has recently been studied by Todd and Hisaw.

The presumption might be that the mothers die from sapraemia after the deaths of the young, but it is hard to understand why mere resorption does not take place. Postmortem findings have been essentially negative.

An explanation should be offered as to why the symphysis does not dilate after the death of the fetus from the hormone injections and let the uterus rid itself of the dead (foreign) body. According to the work of Hisaw, already referred to, the pubic symphysis in



Fig 9 Guinea pig pelvis virgin showing symphysis united

Fig 10 Guinea pig pelvis multipara showing wide separation of symphysis immediately after delivery

the guinea pig dilates at about the time of parturition as a result of the combined action of the female sex hormone and the corpus luteum hormone. It is possible that a certain proportionate relationship is necessary between these two hormones for the act of dilatation and that the injection of excessive amounts of the female sex hormone upsets this fine adjustment with the result noted.

While it may be held that most of the mothers died from the effects of the injections, it is difficult to see why such a large proportion should, especially in view of the results in the second control series of non pregnant females and males, when 6 animals received a total of 600 rat units of oestrin in 6 days with no ill result.

This point should be checked in some animal in which such marked pelvic changes are not necessary for the birth act.

Of course it may be considered possible that an optimum dosage might be found that would terminate pregnancy without the death of the mother.

While interruption of pregnancy in white rats after the fifth day was found impossible by Margaret Smith, when a maximum dosage of 80 rat units was used, it should be remembered that the corresponding stage in the guinea pig would be about 2 weeks. At this stage in the guinea pig we used as high as 150 rat units with positive results. It is quite possible that doses of 100 or more rat units

would interrupt pregnancy in the rat after the fifth day

It is worthy of note that no apparent change takes place in the corpora lutea of pregnancy after the injections of Œstrin. Possibly vital staining methods might have revealed some change. One might perhaps expect some attempt at a compensatory hypertrophy, but the bodies are homogeneous, and there is nothing to indicate that any new lutein tissue is being formed. Indeed, no constant microscopic change can be noted.

A study of the mammary glands during and after the injections was not made. Parkes and Bellerby injected Œstrin in white mice during lactation and succeeded in bringing them into Œstrus ahead of time, but no report on the histological changes in the mammary gland is made.

The general results of the experiments corroborate the findings of Smith and of Parkes and Bellerby and seem to warrant the conclusion that conception and normal pregnancy are not compatible with an excess of Œstrin over corpus luteum hormone in the blood.

Courrier, however, does not believe that the termination of pregnancy is due to the destruction of any balance between the two hormones, but that it is caused by the muscular contractions of the uterus set up by the injections of the Œstrin. If that were true, there would possibly have been some ruptured uteri in our animals in which the young died and the pubic symphyses did not dilate sufficiently to permit their extrusion. Also, Courrier's theory does not explain the prevention of conception, when Œstrin is given just after copulation.

It must be admitted that the termination of pregnancy in these experiments may be due to some peculiar effect on the uterus or placenta, or both, that bears no relation to the corpus luteum. Loeb, in a recent paper, directs attention to his finding that ovulation could be called forth during pregnancy after complete extirpation of the corpora lutea and that maturation of ova is not interfered with during pregnancy. On the other hand his conclusion that removal of the corpora lutea shortens the anŒstrous interval, would indi-

cate that their presence delays the onset of Œstrus.

CONCLUSIONS

1 Small doses of female sex hormone injected into female guinea pigs immediately after copulation for a period of several days will prevent conception in all cases in which an adequate dosage is used. The minimum dosage required is about 10 to 15 rat units.

2 Interruption of pregnancy in this animal when about 2 weeks pregnant can be accomplished in practically all cases with a total dosage of 100 rat units.

3 For animals pregnant about 4 weeks the gestation can be terminated by adequate dosage. An optimum amount for this stage is from 100 to 150 rat units. (With much larger doses the pregnancy is usually terminated by abortion, but the maternal mortality is high.)

4 In females pregnant from 6 to 8 weeks, injections of doses varying from 300 to 1,150 rat units invariably bring an end to normal pregnancy and almost invariably cause the death of the mother.

5 The death of the fetus after injections seems to be related to marked atrophic changes in the chorionic villi, resulting from pressure due to excessive hyperŒmia or other cause.

6 The cause of the death of the mother is problematical.

7 The results with control animals indicate that the abortions and fetal deaths do not result from the injected material or from handling.

8 Administration of as high as 600 rat units of Œstrin in 6 days to males and non-pregŒant female guinea pigs is not incompatible with the life and health of fully grown animals.

9 The conclusion seems warranted that an excess of female sex hormone in the blood over the corpus luteum hormone is incompatible with conception and with the continuance of normal pregnancy in the guinea pig.

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THE DIAGNOSTIC VALUE OF UTEROSALPINGOGRAPHY IN PRE-ADOLESCENT OVARIAN TORSION¹

ROBERT KENT FINLEY, M D, DAYTON, OHIO

A STUDY of the available literature reveals that ovarian tumors in children are rare and that the correct pre-operative diagnosis is seldom made. One purpose of this communication is to describe a diagnostic procedure which led to an accurate pre-operative diagnosis in a case of torsion of a parovarian cyst in a girl of 9 years.

The patient was not in such condition as to require immediate operative interference. We felt justified, therefore, in taking the time necessary to make as accurate a diagnosis as possible before resorting to laparotomy. A review of the literature shows that a fairly large number of abdominal tumors of childhood are not emergency cases, thus establishing the practicability of the procedure which we employed.

The patient was a 9 year old girl, who complained of a mass in the lower abdomen. Two years previously, she had fainted on the street because of severe abdominal pain. Since that time she had had attacks of abdominal pain, sometimes accompanied by the vomiting of greenish yellow material. These attacks recurred at intervals of 1 to 2 months, and lasted from a few minutes to several hours. During the past 6 months the attacks had been more frequent, and the pain became localized in the lower right abdominal quadrant. About 2 months prior to admission her aunt noticed for the first time some abdominal enlargement. One month prior she had a more severe attack of abdominal pain, lasting several hours, and accompanied by vomiting. During the next few days the abdomen became visibly larger, and her physician was consulted.

Physical examination revealed a rather poorly nourished female child. The breasts were not developed, axillary and pubic hair was absent. Labial hair was present in more than the normal amount for a child of this age. There was a tumor occupying the mid portion of the lower abdomen and extending to within 2 inches of the umbilicus. It was smooth, and the overlying tissues moved freely over it. It had a semi solid consistence, no fluid ballottement could be demonstrated. No placental souffle or fetal heart sounds could be heard. Rectal examination revealed a tumor lying in the pelvis and seeming to move with the cervix. The bladder emptied completely on catheterization and contained a normal amount of urine. Blood counts and urinalyses were

negative and X-ray studies failed to disclose any opaque mass, teeth, or bone. Our impression was that we were dealing with a uniform enlargement of the uterus.

Under gas oxygen anesthesia a pelvic examination was made. The vaginal orifice was small, barely admitting one finger. It was partially closed by an intact crescentic hymen. The cervix was palpated high in the vault posteriorly and in front of the cervix was a semi fluctuant tumor. The mass filled the pelvis, extended to the umbilicus, and could be moved but slightly. Under aseptic precautions 3 cubic centimeters of iodized oil (lipiodol) was injected into the uterine cavity, as the child lay on the cystoscopic table, and an X ray film was exposed. Two additional cubic centimeters of the iodized oil was then injected, making a total of 5 cubic centimeters and a second film was exposed. The roentgenogram showed a triangular uterine cavity of normal capacity for a child of this age, the cornua appeared to be somewhat enlarged. The uterus was displaced toward the right. The right tube was elevated, abnormally long, and was observed to describe a spiral. Free lipiodol was seen about the fimbriated extremity of the tube at a point corresponding to the upper limit of a faint shadow cast by the tumor mass. Evidently the right tube was attached to the tumor mass and was being pulled up into the abdomen by it. The left tube was elongated, extremely tortuous, and doubled back on itself so that the fimbriated extremity was pointing toward the uterus. There was free lipiodol about its distal extremity.

On the basis of these findings a diagnosis of torsion of a right ovarian cyst was made. Inasmuch as the child was somewhat dehydrated, and since her condition was not such as to demand immediate operation, forced fluids were instituted and she was sent home for a 15 day rest.

Operation. Under gas oxygen anesthesia the abdomen was opened through a central incision, and a bluish cystic mass was seen, occupying the mid portion of the abdomen and pelvis. There were fairly organized adhesions to the colon over the entire extent and a few to the small bowel. After the adhesions were freed the tumor was seen to be a cyst of the right ovary with torsion of the pedicle, the pedicle consisting of the fallopian tube, thrombosed veins, and part of the broad ligament. It lay anterior to the broad ligament, with the pedicle twisted three complete turns in a clockwise direction. The pedicle was clamped and the tumor was delivered. The left ovary was about 2.5 centimeters in diameter and appeared to have multiple cysts throughout. A section was excised for examination and the

¹ Thesis submitted to the Faculty of Surgery of the Graduate School of Medicine of the University of Pennsylvania in partial fulfillment of the requirements for the degree of Master of Medical Science (M. Sc. (Med.)) for graduate work in Surgery.

abdomen was closed. The child made an uneventful recovery and was sent home on the tenth day. The report of the pathologist Dr. Walter Simpson, was as follows: "Gross pathology, monolocular parovarian cyst 13 by 10 by 8 centimeters weight 452 grams. The wall was reddish purple in color due to hemorrhagic infarction caused by twisting of pedicle. The attached fallopian tube also showed hemorrhagic infarction. A small piece of the ovarian tissue was examined microscopically and showed multiple immature follicles and small follicular cysts, most marked just beneath the serosa. The wall of the monolocular cyst showed diffuse recent hemorrhagic infarction with early simple necrosis. The cyst was lined with low simple columnar epithelium. No evidence of malignancy was found."

In establishing the pre-operative diagnosis, several possibilities were considered. Among these were gynatresia (1), sarcoma of the uterus (1, 26),¹ sarcoma of one ovary (34), dermoid of the ovary, some anomaly of the bladder, and pregnancy.² Our attention had been called to the work of Heuser who first suggested the use of lipiodol in the diagnosis of early pregnancy. He stated that it would not produce abortion and it was not dangerous to use. He described the picture produced in an early pregnancy. We did not follow his suggestion of producing pneumoperitoneum first, nor the technique of McCreedy and Ryan in taking a stereoröntgenogram. Had we followed these precautions we could, no doubt, have demonstrated the torsion of the tube very well. As it was, our findings left no doubt that we were dealing with a tumor of the right ovary and that the right tube, describing a spiral, was intimately connected with it. While the use of iodized oil in differential diagnosis of pelvic conditions is said to be not without danger (4, 11, 14, 18, 32), it has passed the experimental stage and its value is attested by many excellent articles (6, 8, 9, 16, 17, 19, 24, 25, 27, 28, 30, 37, 38). We feel that this case illustrates a condition in which the differential diagnosis was of great importance, and could only be made by the injection of some opaque medium and radiographic study.

We allowed a period of 17 days to elapse between lipiodol injection and the operation,

¹Lewis Schilley (34) states that in children sarcoma varies from 18 to 25 per cent of all ovarian neoplasms. They produce a rapidly growing freely movable pelvic or abdominal tumor.

²De Lee (De Lee's Obstetrics, p. 2) quotes Budd as saying that girls of 9 and 10 years have borne children.

feeling with Anspach and Hirst that it is safer to wait for some time following the injection before operation. It was felt, moreover, that a more severe reaction might be experienced in a child than in an adult, in the absence of any literature on the subject. As a matter of fact the child had some abdominal rigidity and pain for 2 days following the injection, unaccompanied by a rise in temperature.

Torsion of the uterine adnexa before puberty is an extremely rare condition, judging from the few cases reported. Smith and Butler reviewed the literature from 1900 to 1921 and were able to collect 25 cases. They also reported one of their own. We have reviewed the literature from 1920 to the present date and have collected 25 cases, abstracts of which follow. These cases seem to fall conveniently under three headings: (a) torsion of abnormal adnexa, (b) torsion of normal adnexa in abnormal situations, (c) torsion of apparently normal adnexa normally situated.

Torsion of abnormal adnexa. The torsion of abnormal adnexa is not hard to understand. Jellett (36) says that any tumor of the ovary which is not bound down by adhesions and which has a definite pedicle may undergo rotation. This is by no means a rare condition in adults. A Martin (33) reports that 5 per cent of his cases have undergone torsion, B. Kustner (33) reports 47 per cent, and Stein (36) gives from 8.5 per cent to 15 per cent.

One anatomical condition favoring torsion is a freely movable tumor with a well developed pedicle, presenting smooth rounded surfaces. A large cystic ovary, which by its weight has pulled upon its attachment, will produce for itself a well developed pedicle, and will acquire free mobility. Conditions being favorable to torsion, this accident may occur through the action of one or several causes. As the tumor grows it rises out of the pelvis very quickly in children (23), but during its early development it rests upon the pelvic walls. The dorsal and lateral surfaces are compressed by the contact with the bony pelvis while the ventral and medial surfaces develop. This, coupled with the shape and tilt of the pelvis, tends to cause rotation toward the midline (2). The explanation of Kustner's law, which states that tumors of the

right side usually rotate from right to left and tumors of the left side rotate from left to right is no doubt based on these anatomical conditions (36)

Among other factors which may enter into the development of torsion, Kohler quotes Sellheim as saying that the inertia from a uniform twisting motion of the body may be transmitted to a tumor and cause it to undergo torsion on its pedicle. This is most apt to occur to a mass which is freely movable, its surfaces smooth, and its contents fluid. Torres reports a case of torsion probably caused by a fall from a chair. Anspach (3) mentions the effect of some sudden unusual exertion, such as lifting or straining at stool, which abruptly increases intra-abdominal pressure, thus rotating the tumor. Peters finds that during a coughing spasm the small intestines are thrown down into the lower abdomen suddenly and with considerable force. If an ovarian tumor should be present, the impact of the intestinal mass against the tumor would be a factor in producing torsion. Other writers suggest a sudden decrease in the pressure as the emptying of an overdistended bladder, and in the adult the emptying of a gravid uterus, as being a factor in producing torsion.

Payr (39) offers a hæmodynamic theory. He experimentally induced torsion in different organs by increasing their venous pressure. He showed that if the veins of a pedicle become engorged, torsion may go on without any other additional force. It is well known that veins of pedicles are longer than the arteries associated with them, and that their walls are thinner, and stretch easier than do the more muscular walls of the arteries. A slight pressure on a pedicle insufficient to interfere with the lumen of the artery may be sufficient to compress the veins, bring about their dilatation and elongation, and cause them to describe a spiral around the more fixed parts of the pedicle, namely, the connective tissue and the artery. Such spiral turns of the veins may, according to Payr, carry the cyst, if not too large, around the pedicle and bring about torsion.

While tumors of the ovary in children must comprise a very small percentage of all

ovarian tumors, their number is by no means negligible. Weil (10), in 1904, collected 60 cases of ovarian tumors in children up to 10 years of age which he placed under the following classifications: dermoids, 21, or 35 per cent, cysts, single or multilocular, 19, or 31.6 per cent, sarcoma, 15, or 25 per cent, carcinomata or papillomata, 8, or 8.4 per cent. To these Downs added 26 cases comprising simple cysts, 2, dermoids, 8, malignant tumors, carcinoma, or sarcoma, 16.

Downs feels that the higher percentage of malignancy reported in the later cases can be accounted for by the more careful histological study to which such growths are subjected. Howard Kelly (Keating's *Cyclopedia of Diseases of Children*) collected 126 cases of ovarian tumors in children which he classifies as follows: cystic tumors—adenocystomata, unilocular, dermoid (cysts), solid tumors—sarcomata, carcinomata.

Downs believes that even in the fetus simple cysts may reach considerable size. Findley quotes Dornas' report of finding proliferating cysts in the ovary of a 7 month fetus, and states that Boulard found numerous cysts in a stillborn child. According to Downs the most common complication of tumors is torsion, and they are most apt to occur in growths of moderate size.

Torsion of normal adnexa abnormally placed. This, according to Heineck, occurs only as a complication of congenital hernia of the inguinal type. In 1912, he collected from the literature of the preceding 20 years 5 cases of torsion of the ovary and 18 cases of torsion of the ovary and tube in hernial sacs. It is an accident of infancy. It is a true torsion and is to be differentiated from strangulation of the contents within the sac. The youngest patient was 1 month of age, and the oldest case was 5 years old. The majority are in their first year. It is of about equal frequency on each side. Pathologically, the same changes occur as in torsion in the abdomen. Damianos (35) thinks that Payr's theory explains their occurrence. Auvray says that the spiral course of the tube, normal in fetal life may persist. This could be a predisposing factor. The clinical picture is that of an atypical strangulation of an omental or intestinal hernia.

Obstipation is usually absent, and the general condition in most cases is not serious. There is not the same tendency for the case to become progressively worse as in intestinal hernia.

Torsion of normal adnexa normally placed
This condition in children is more difficult to explain. In fact, it seems impossible for it to occur in an entirely normal ovary. We must broaden our classification to include those organs which, while they are not abnormal histologically, do present abnormal anatomical characteristics. As Smith and Butler (14) point out, an ovary may be normal histologically and yet be mechanically predisposed to torsion. These mechanical or anatomical abnormalities would include an excessively long mesovarium, a long tube, or an unusually large heavy ovary, which would pull away from its attachment sufficiently to form a pedicle. Also Auvray's premise (that the spiral course of the tube, normal in fetal life, might persist in extra uterine life) could be a predisposing factor. Among the cases so classified, Smith and Butler place their own and four others. In their case the ovarian tissue was destroyed, being replaced by partly organized clots, and there was a small cyst present. Of the four which they abstracted they question the propriety of so classifying two in which the ovaries were said to be the size of a lemon. No histological study was done in either case. In the two remaining cases one (Johannson) stated that at the time of operation the ovary was enlarged four or five times and that the pedicle was twisted once. The mesovarium was unusually long. Microscopically the ovary was completely infarcted and no microscopic details were discernible. The other case (Cassidy and Norbury) was one in which the left ovary and tube and the corresponding broad ligament were twisted. No mention is made of the size of the ovary. The histological examination showed only extreme vascular engorgement. (Tolle's case showed a mass the size of a tangerine. On histological study it was impossible to identify any ovarian tissue, the mass being composed wholly of necrotic tissue with leucocytic infiltration.) Cohen's case showed a bluish black sausage shaped mass which in-

cluded the tube, no ovarian tissue could be identified. The mass was composed entirely of blood cells with an occasional thin strand of connective tissue.

That the correct diagnosis in cases of torsion of the uterine adnexa in children is seldom made is shown by the following summary of pre-operative diagnoses in the cases collected by us.

| | Cases |
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| Ovarian tumor | 1 |

Due to the relative infrequency of this accident it is, doubtless, seldom considered as a possibility. With the condition in mind, however, there has been little to guide one in confirming the diagnosis. The factors which determine the violence of the systemic disturbance are the degree of torsion, and the rapidity with which it occurs. We can expect symptoms varying from a very slight abdominal pain, and the appearance of an enlarging, painless abdominal tumor to symptoms of a severe abdominal crisis, with shock, rapid pulse, and severe gastro intestinal disturbance. Ovarian tumors in children rise out of the pelvis early in their development, so that if a mass is palpable, it may be mistaken for the kidney or the spleen. Downs says that by rectal examination the cord like pedicle can be felt. This is not mentioned by other writers where a rectal examination was made, and we were unable to feel the pedicle in our case. Koucky says that in torsion of an ovarian pedicle there is pain referred to the outer aspect of the upper third of the thigh on the affected side. X ray alone is helpful in cases of dermoid cysts where there is enough calcium deposit to cast a shadow. Marshall found that in a series of 100 cases of dermoid cysts examined at the Mayo Clinic 26 per cent showed calcium deposit, and that in a series of 415 cases of dermoid cyst the correct pre operative diagnosis was made by X ray demonstration of teeth shadows in 3 cases.

Realizing the obstacles in the way of correct diagnosis, we feel that lipiodol injections in those cases which do not present serious

symptoms are quite as justifiable and helpful in children as in adults. If the method is used, the amount of opaque substance injected must be adapted to the size of the uterine cavity of the patient. We would expect no untoward results from this procedure, and the value of the information gained would more than compensate for any inconvenience which the examination would cause the patient.

TORSION OF ABNORMAL ADNEXA

CASE 1 Reported by Erwin Baumann (40). A girl of 14 years, who never had menstruated, gave history of cramps in abdomen. She experienced sudden cramps and vomiting after coasting. A round tumor reaching to the umbilicus was found. Turning of cyst was suspected. Pulse was 100 and temperature 99.1 degrees. At operation 320 cubic centimeters of serous bloody fluid was found in the abdomen. A cystoma, twisted twice 180 degrees was removed. There was cystic degeneration of long pedicled ovary, which weighed 750 grams. It showed hemorrhagic infarcts, multilocular cysts and solid dense spots. Patient recovered.

CASE 2 Reported by Delmas (46). A girl aged 13 years had a normal temperature and pulse of 80. Her general condition was good. She had a sudden sharp pain in suprapubic region, localized at first to the left of the median line, and then became generalized. This was soon followed by vomiting. A median, infra-umbilical mass was palpated. It was hard and taut, but not painful. Pre-operative diagnosis was as follows: (a) volvulus of small intestine, (b) hæmatometra or left hæmatosalpinx. At operation a twisted cyst of the left ovary was found. The cyst was composed of three pockets, one cystic and filled with bloody fluid, two dermoid in character. The tube and round ligament were involved in torsion. Patient recovered.

CASE 3 Reported by O. Wallerstein (60). A 9 year old girl experienced violent pains in the pelvic region, accompanied by vomiting and constipation. Her general condition was good. Rectal temperature was 38 degrees C. There was "defense musculaire" in left inguinal region. Pre-operative diagnosis was appendicitis. Operation was performed. The peritoneum was dark looking and contained free bloody serous fluid. The appendix was free. The twisted cyst of the left ovary was the size of a hen's egg and totally infarcted. The girl recovered.

CASE 4 Reported by J. Gainza Echeverri and A. Metraus (47). Baby girl aged 2 years had had digestive disturbance since birth. The present attack was ushered in by vomiting with continued nausea. There were several acid, seromucous, greenish stools. The child had no fever. There was smooth orange sized swelling in the midline of the hypogastric region, having clearly defined boundaries, movable in all directions. The pre-operative

diagnosis was (a) serous cyst of mesentery, (b) sarcoma of left ovary. At operation a cystic tumor of the left ovary with the tumor twisted three times on its pedicle was revealed. Patient recovered.

CASE 5 Reported by N. Holtmann (50). A girl of 15 years was first operated upon for acute appendicitis. One month later the pain recurred. The child was underdeveloped for her age. She had not menstruated. Her temperature was 37.3 degrees C. The tongue was dry. There was tenderness to pressure in hypogastric region. On rectal examination a tender mass the size of an apple was discovered. Its form changed when the patient attempted to rise. Diagnosis was (a) hæmatometra, (b) cyst. On operation a solid bluish red tumor was found on the right in Douglas' pouch. It was about the size of a small fist and was twisted 360 degrees on its pedicle in a clockwise direction. The uterus was absent, though the left ovary, both tubes, and the vagina were present. Microscopic diagnosis showed dermoid cyst of the right ovary with hemorrhagic infarction of the wall. Patient recovered.

CASE 6 Reported by V. Riche (58). A girl of 11 years whose general condition was good, who had a normal temperature and pulse of 80, had a sudden attack of pain in the right side with vomiting. She had experienced several previous attacks. There was a painful swelling about the size of a tangerine in the right side. The inferior pole corresponded to McBurney's point. Pre-operative diagnosis was appendicitis. At operation a cyst of the right ovary was found twisted two and one half times upon its pedicle in a clockwise direction. Histological study was not then complete. The girl recovered.

CASE 7 Reported by Y. Bourde (41). Girl 11½ years old had a sudden left sided abdominal pain. Her temperature was 37.5 degrees C, pulse 122. Her general condition was good. She had had three similar attacks previously. Palpation gave a fluctuating mass which measured 8 centimeters in height and 14.9 centimeters in breadth. Roentgenography gave a rather light but fairly clear shadow. Pre-operative diagnosis was not given. At operation there was found a large mucoid cyst of the left ovary which had passed over to the right side. Its pedicle was twisted exactly three times in a counter clockwise direction. Right adnexa, uterus, and appendix were normal. The cyst which was removed weighed 800 grams. There was no microscopic report. The girl made a normal postoperative recovery.

CASE 8 Reported by Y. Bourde (41). Baby girl aged 20 months had been malnourished since birth. She also had enlarged liver since birth, which had decreased under specific treatment. Lower abdomen, however, continued to enlarge. This enlargement gave signs of free fluid in abdominal cavity. She had had an attack of violent pain in the right side of the abdomen. Pre-operative diagnosis was (1) ascites, (2) cyst of mesentery, (3) dilatation of the colon. An enormous mucoid cyst of the right ovary was seen at operation. There was a pedicle twist of more

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Fig 1 Shows the symmetrical enlargement of the lower abdomen, which extends to the umbilicus

80 per cent polymorphonuclears. There was abdominal rigidity and tenderness to pressure. A preoperative diagnosis of appendicitis was made. At operation a hematosalpinx was found on the right. The tube was twisted two and one half times, and the ovary showed a hemorrhage cyst. There was a large cystic ovary on the left. Right tube and ovary were removed. The child recovered.

CASE 17 Reported by Mark S. Ruben (59). Patient $7\frac{1}{2}$ years old had pain in the left lower abdominal quadrant with vomiting. There was no abdominal rigidity. A soft globular mass was felt in the lower right abdominal quadrant. At operation an ovarian cyst was removed from the right side. It was of grape fruit size with twisted pedicle. The girl recovered.

CASE 18 Reported by Mark S. Ruben (59). Girl, aged 14 years, had an acute attack of pain in the abdomen. She gave the history of a sticking pain in the right side for several years. A tense cystic tumor was felt in the midline of the lower abdomen, rising to two fingers breadth above the umbilicus. A large cyst of the right ovary with a twisted pedicle was removed at operation. The patient recovered.

Ruben also reports the case of a girl aged 4 years, who had three acute attacks of abdominal pain with fever and vomiting. She recovered spontaneously, but he feels that this was also a case of torsion.

CASE 19 Reported by W. M. Powell (56). A five month old baby girl had acute abdominal symptoms demanding operation. The uterus and appendages were so affected by torsion that it was necessary to remove them entirely.

CASE 20 Reported by E. Heinze (49). Child aged 6 years, whose previous history was negative, was taken suddenly ill with abdominal pains, which were more severe on the right side below the umbilicus. The child vomited once. Temperature on admission was 100.4 degrees, pulse 128. There was slight tension of the abdominal walls with tenderness on deep pressure over McBurney's point. Preoperative diagnosis was appendicitis. At operation an egg sized tumor of the right ovary was found. Its pedicle was turned once to 180 degrees in a clockwise direction. The right ovary and ampullar part of tube were removed. Appendectomy was done. She recovered.



Fig 2 A ray plate taken after 3 cubic centimeters of iodized oil was injected into the uterine cavity. The body of the uterus is deflected toward the right. Both cornu are markedly developed. The right tube can be followed through one complete turn. The tube appears to be much elongated, and high up out of the pelvis. The fimbriated extremity is marked by the heavy deposits of iodized oil at F and F'. An oval shadow, cast by the tumor mass, can be made out. The left tube is much elongated and doubles back upon itself.

CASE 21 Reported by M. Pierre Laurent (52). A 7 year old girl had suffered from attacks of abdominal pain, coming on acutely, and at irregular intervals for a year and a half. The present illness was inaugurated by a very severe attack of abdominal pain accompanied by vomiting 4 days previous to hospitalization. The child was prostrated. Her pulse rate was 130, temperature 38.



Fig 3 The tumor mass showing the large cyst with the pedicle (at the top) consisting of the right tube and part of the broad ligament.

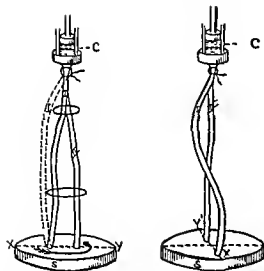


Fig. 4. Illustrating Payr's theory. *S*, is a disc to which are attached two tubes. *I* is thin walled and represents the vein. *II* is thick walled and represents the artery. *II* is filled with water and tied off at both ends. Water is forced under pressure from the chamber *C* into the tube *I*. The tube becomes elongated and the disc is rotated as shown in the second drawing. (After Payr)

degrees C. She had moderate abdominal distention, besides muscular rigidity and generalized abdominal tenderness. The pre operative diagnosis was acute appendicitis with peritonitis although the general picture was not considered typical. At operation a simple cyst of the right ovary twisted three times on its pedicle was revealed. The pedicle consisted of the right tube and a portion of the broad ligament. The involved structures were removed and the child made an uneventful recovery. No histological study was made.

TORSION OF NORMAL ADNEXA ABNORMALLY PLACED

CASE 22 Reported by Breteche (43). Patient was a child of 3½ months. Illness had an acute onset with vomiting, obstipation, and swelling in the right groin. Pre operative diagnosis was strangulated inguinal hernia. Operation was performed and in the sac, instead of the gut, the right ovary and part of the tube were found. There were three complete turns of the pedicle of the adnexa. The diseased organs were removed, and the wound was closed. The child recovered.

CASE 23 Busch (44) reports a hernia in a girl 10 days old, containing an ovarian cyst, the pedicle of which had undergone torsion.

TORSION OF NORMAL ADNEXA NORMALLY PLACED

CASE 24 Reported by Morris Cohen (7). Girl, aged 13 years, who had never menstruated gave an uneventful past history. The present illness had existed 4 days with symptoms of sharp pain in the

lower right abdominal quadrant with some vomiting. She also complained of frequent and painful micturition. The right lower abdominal quadrant was very tender and rigid. No masses were palpated. A blood count showed leucocytes 17,800 with a differential count of 89 polymorphonuclears and 11 lymphocytes. Temperature was 102.8 degrees F, pulse 100, respiration 26. Pre operative diagnosis was acute appendicitis. At operation a tumor mass was delivered which consisted of the right ovary twisted in a clockwise direction upon the tube and mesosalpinx. The appendix appeared to be inflamed at the tip and was removed. The adnexal mass consisted of a kidney shaped tumor 12 by 6 by 3 centimeters, along the concave side of which the uterine tube was attached. It was removed. Microscopically ovarian tissue could not be recognized, the mass being comprised of blood cells with an occasional strand of connective tissue. The patient recovered.

CASE 25 Reported by F. Neugbauer (55). Girl aged 6 years, was taken acutely ill. There was pain in the ileocecal region without muscle rigidity. She had been vomiting. Her temperature was 37 degrees C. Pre operative diagnosis was inflammation of the caecum. She had had two previous attacks lasting 24 hours with sudden recovery. Operation disclosed a thin layer of clotted blood covering the omentum and intestines. The appendix was normal but was removed. The right ovary and tube were enlarged into a bluish red tumor due to engorgement with stagnated blood. The pedicle near the uterus was rotated around its own axis. There were no adhesions or other regions of inflammation. The right adnexa were removed and the patient recovered. The tumor was 5½ centimeters long and its greatest circumference was 11 centimeters.

SUMMARY

1. A case of torsion of an ovarian cyst in a 9 year old child is reported which was diagnosed by uterosalpingography.

2. A review of the literature on torsion of the adnexa before puberty is presented.

3. All cases reported since 1920 to the present date are collected and classified.

4. The practicability of uterosalpingography as a diagnostic aid in certain of these cases is pointed out.

I am greatly indebted to Dr. Marshall M. Best of Xenia, Ohio, for his co-operation and suggestions in studying this case. My thanks are also due Dr. Walter Simpson, head of the pathological department of Miami Valley Hospital, Dayton, Ohio, for his accurate and painstaking study of the specimen.

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CLINICAL SURGERY

FROM THE SURGICAL CLINIC, CHARITÉ HOSPITAL

THE SURGICAL TREATMENT OF TUBERCULOUS CAVITIES OF THE LUNGS WITH FILLING—"PLOMBE"

PROFESSOR R. NISSEN, BERLIN, GERMANY
Oberarzt der Klinik Professor Sauerbruch Director

THE method of obliterating cavities in lung tissue by inserting a filling between the wall of the thorax and the surface of the lung was originated by Tuffier. He used the patient's own fat for this purpose. However well founded the idea was, the results of such treatment were uncertain for several reasons. In the first place, emaciated tuberculous patients rarely have enough fat available to fill completely the large cavities which often remain after the diseased lung area is detached from the wall of the thorax. And, too, soft fat is not capable of resisting the pressure exerted on the rigid wall of the cavity.

Baer's technique was a decided improvement in the carrying out of Tuffier's plan. Instead of fat he used paraffin with a high melting point—a mixture which hardens at body temperature and so meets the mechanical requirements better. Sauerbruch was the first to carry out this operation in a large number of cases. A number of difficulties were encountered at first in the development of Baer's technique, and only recently with increasing experience have more definite indications been worked out for its use and have the technique and after treatment been improved.

On the whole the method is used only in the surgical treatment of cavities. Complete obliteration of the pleural space is even more necessary in this method than in thoracoplasty. Obliterating material that is placed on the delicate, non-adherent pleura descends through the force of gravity, and thus may tear the parietal pleural and penetrate the free thoracic cavity. It is therefore imperative that pneumothorax be applied before operation is undertaken. Often this is the only way of determining the presence and extent of adhesions. Another essential to good results is that the wall of the cavity be strong enough to withstand the pressure of the paraffin, which may be sufficient to break down the layer of lung or connective tissue between it and the cavity, if the layer is

thin. The obliterating material then would break into the cavity—a most dreaded complication—and lead to serious irritation there. If severe infection does not make immediate removal necessary, the paraffin is coughed up in small bits. Small hæmorrhagic infarcts which arise after the necessary pneumolysis stimulate the development of such areas of pressure necrosis over thin cavity walls. The infarcts may be attributed to the fact that the blood supply of the wall of the cavity is partly taken over by vessels that pass from the wall of the thorax through the pleural indurations to the lung tissue. It is known from experimental investigation (Schlaepfer) that extensive venous communications are present. In detaching the lung, the veins are torn and the interruption of the circulation leads to circumscribed areas of congestion and hæmorrhagic infarcts which can be demonstrated anatomically (Nissen). However, this danger of pressure necrosis is present only when the wall of the cavity is very thin, that is, when it is a part of the pleural induration. Often very hard or even calcified indurations make pneumolysis and therefore obliteration impossible.

Information as to the distance between the inner wall of the cavity and the surface of the lung can be obtained by physical examination, particularly by means of the roentgenogram in two planes or by means of stereoscopic pictures.

Two things must be considered in deciding whether this operation is indicated. First, if one half of the lung is involved and the other half is not in condition to bear total obliteration of the diseased side by thoracoplasty, then the cavity, which generally lies in the upper part of the thorax, can be filled in order to overcome the chief focus of dissemination of infection and danger of aspiration. It is not easy, as every one knows, to judge how much the sound side will stand. In addition to the physical findings, we must take into consideration age, general condi-



Fig 1 Roentgenogram taken before operation, showing badly diseased left cavity, and slightly diseased right cavity



Fig 2 The same patient as shown in Figure 1 after the filling (plombe) had been placed in left lung

tion, heart action, and other factors. The obliterating material excludes only a small amount of the breathing lung tissue, a factor of great value in such cases. At times it is justifiable to insert the paraffin on both sides (Figs 1-5).

Compression of the lung by thoracoplasty is rarely indicated in patients more than 45 years of age. The indications for paraffin treatment can be considerably extended in such cases.

The point of preserving only functioning lung tissue is also a decisive factor in deciding whether the obliterating operation shall be used. If cavernous phthisis is present *only in upper part of the thorax* (Figs 6-9) but the rest of the lung is free, the paraffin retracts the diseased focus and spares the normal tissue and so brings about healing. The objection might be made that in such cases a circumscribed thoracoplasty would accomplish the same thing. That is not true, however. In the first place, the purely mechanical effect of a partial plastic operation is generally insufficient and not comparable to the retraction brought about by the complete filling of the cavity. And, too, a circumscribed thoracoplasty over the upper lobe—and these cases are almost always in the upper lobe—means increased danger of aspiration of secretion into the breathing lower lobe. The fact that the part of the chest wall is deprived of its bone causes paradoxical respiratory movements at first after the operation and experience has shown that this means great danger of aspiration. In the obliteration treatment, for which it is necessary to remove only a short piece of one rib, the normal movements of the wall of the thorax are preserved. Aspiration was feared at first, but it is now known that it practically never occurs.

Another indication for paraffin treatment is the presence of severe recurrent hæmoptysis (Fig 10). If life is threatened then, of course, the method of choice is artificial pneumothorax. If this does not bring good results, then collapse of the bleeding cavity should be brought about by filling. As operation in these cases is an emergency one to save life, the further extent of the disease is not taken into consideration.

Finally, the paraffin treatment can be used advantageously when, after the ribs are resected, a rigid system of cavities does not collapse completely. Then the effect is better and lasts longer than when extrapleural tamponing is done.

TECHNIQUE

The technique is as follows. Through a paravertebral incision, which we prefer to an approach from in front as recommended by Baer and others, the musculature is split and a piece of about 3 centimeters long is resected subperiosteally from the third or fourth rib (depending on the position of the cavity), near the angle of the rib (Fig 11). Great emphasis must be placed on careful hæmorrhage in the sectioned muscles. The finger is introduced carefully between the pleural induration and the wall of the thorax in the layer in which the finger finds the least resistance (Fig 12). No strictly anatomical instructions for this can be given. The direction in which to make the dissection between intrathoracic fascia and thoracic wall is of little value as the induration generally makes impossible any differentiation between the layers.

As a rule the pneumolysis is made between the two folds of the pleura. If the right layer, that is, the least resistant one, is found, generally it is



Fig 3 Patient with cavities on both sides suitable for double filling



Fig 4 The same patient as shown in Figure 3 after filling (plombe) on left side

easy to dissect the whole cupola of the lung with out difficulty. It is rarely necessary to dissect hard cords with strong pressure, scissors, or a knife. The extent of the pneumolysis is determined by the size of the cavity (Figs 13-15). This is easily determined because the cavity (Fig 16) can be palpated in the freed lung even through strong indurations. Usually the whole upper lobe should be dissected free from the vault of the thorax and the posterior and lateral parts of the lung be pushed down to the fifth and sixth ribs. Careful attention must be given to any possible tears in the lung. These are shown by the escape of air and can be seen readily on the coughing of the patient. If such tears are small they can be closed by suture and the insertion of paraffin risked. If, however, the lung tissue is extensively injured or the cavities have perforated, the per-

forations should not be sutured or the paraffin inserted but a thoracoplasty should be done. It is therefore advisable to extend the local anesthesia, under which we always perform the operation, from the second to the sixth intercostal space. Hemorrhage is generally slight even in the presence of a large cavity. Hemorrhage can be controlled by putting in gauze strips for a short time. If the strips are moistened with 40 per cent alcohol solution the hemostatic action is increased. After the gauze is removed the cavity is filled with a mass of paraffin which is of such consistency that it can be kneaded. Generally 500 to 600 cubic centimeters is sufficient. We have, however, used as much as 1,000 to 1,200 cubic centimeters successfully (Figs 13-15), but we have abandoned this practice as several times the paraffin ruptured through the cavity.



Fig 5 The same patient as shown in Figures 3 and 4 after insertion of paraffin (plombe) on both sides



Fig 6 Cavity system seen in left apex



Fig 7 The same patient as in Figure 6 after filling

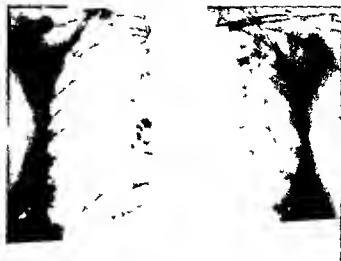


Fig 8 A cavity in the left lung

The material is prepared as follows: 75 cubic centimeters of paraffin with a melting point of 58 degrees is melted with 25 cubic centimeters of paraffin with a melting point of 43 to 44 degrees C. One cubic centimeter of bismuth carbonate and 0.05 cubic centimeter of vioform are added to a small amount of this mixture. Uniformity is obtained by stirring the mixture for $\frac{1}{2}$ hour, gradually adding the rest of the paraffin. The mass is put into sterile glass vessels with tight covers and sterilized in a vapor sterilizer on 2 successive days for an hour each. Before using, the vessels are heated in a water bath and shaken to make the mixture uniform. The liquid is poured into sterile porcelain dishes in which it is allowed to cool until it is of the right consistency. When it is used, it must be homogeneous through

out, pale yellow, and soft enough to knead readily. When the cavity is filled to the level of the ribs with the paraffin, the resection opening is closed by pulling together the musculature of the adjacent intercostal spaces (Figs 17-19). The operation is completed by suturing the muscles, fascia, and skin in layers.

For the first few days after the operation systematic attention must be given to the coughing up of accumulated material. Ordinarily the temperature rises correspondingly, though the wound is in perfect condition, the pulse may be 120 or more a minute. This intense reaction is the result of the sudden and strong compression of the tuberculous tissue. The toxins are pressed from the



Fig 9 The same patient as in Figure 8 after insertion of filling



Fig 10 The filling was put in the left lung because of the presence of severe hemoptysis that threatened the life of the patient. The process in both lungs was spreading widely.

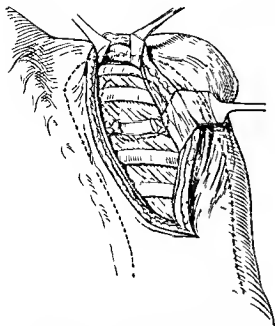


Fig 11 Paravertebral incision exposing the ribs. About 3 centimeters of the third rib was resected. The margins of the cavity and of the lung are outlined by interrupted lines.

diseased region into the circulation. They cause a sort of tuberculin action such as is not infrequently seen in pneumothorax and, in a milder form, in paravertebral thoracoplasty. While in the latter method retraction of the lung occurs gradually, this general reaction from the focus is not so marked as in the paraffin filling method.

On the second or third day the temperature ordinarily falls again, the pulse becomes less rapid, and expectoration, which was scanty at first, becomes more profuse, generally far beyond what it was before operation. Traces of blood, which are frequently seen and which are probably due to friction of the cavity walls or small hemorrhagic infarcts, are not of serious importance.

If there is continuous fever and a feeling of pressure on the side operated upon and if the external wound does not show signs of inflammation, it suggests an exudate around the paraffin filling. Even small amounts of fluid cause considerable signs of pressure in the bed of the filling. Ordinarily the exudate becomes subcutaneous and can then be recognized by fluctuation. The effusion is emptied, as is a cold abscess, by puncture. Aspiration is continued for several days or even weeks, even when the exudate becomes purulent and contains pus bacteria.

When there was severe mixed infection of the bed of the paraffin, we frequently used to open

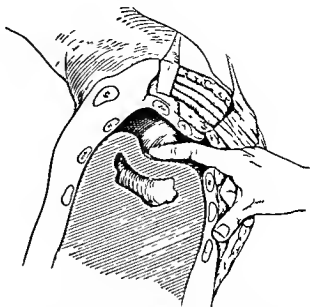


Fig 12 Transverse section used in pneumolysis. The finger is placed between the pleural induration and the thoracic wall.

the wound and remove the paraffin. But experience has shown that even with pus and bacteria present, puncture is usually sufficient. In recent years it has only rarely been necessary to remove paraffin due to infection of the bed of the paraffin.

A much more severe complication, which occurs much later, sometimes not until years have elapsed, is rupture of the paraffin into the thoracic cavity and bronchi. Small bits of paraffin are then coughed up. It is a striking feature that in spite of the communication between the bed of the paraffin and the bronchial tree the latter only rarely becomes infected. Even rupture of the paraffin is rare if only cavities with strong walls are compressed with moderate amounts of paraffin. The treatment in such cases consists in removal of the paraffin and extrapleural and paravertebral rib resection over the paraffin mass. The resection must be carried up to the first rib and down to the seventh or eighth rib, so the shoulder blade may lie in the defect in the wall of the thorax.

Unfortunately, it is not always possible to obliterate the residual cavity at one sitting. Secondary operations make considerable demand on the already taxed strength of the tuberculous patient. Not infrequently the tuberculous tissue in the region of the fistula breaks down. The massive suppuration from the cavity opens upward and causes catastrophe. The few cases of death that have occurred after paraffin treatment are to be attributed to this severe complication.



Fig 13 A large cavity present in the right lung

The paraffin treatment may cause complications indirectly by constricting and distorting the chief bronchus at the hilus. This would cause interference with expectoration from the cavity region and also from the rest of the lung on that side. Congested secretion would disseminate the infection and large foci of liquefied tissue would develop. Fortunately this outcome, which cannot be foreseen when the paraffin filling is put in, is rare.

Occasionally the mechanical action of the filling material is insufficient. There are two reasons for this. Later, on clinical and roentgen examination, it is sometimes found that the paraffin has not compressed the cavity completely. In such instances another pneumolysis may be done and additional filling material is inserted. A second reason for insufficient mechanical action is that the upper lobe of the lung, particularly if there is a rigid cavity system and delicate pleural adhe-



Fig 14 Lateral view of same patient as shown in Figure 13 after a large filling in cavity

sions, may be pushed as a whole toward the hilus and downward without very much compression of the cavity. We have not seen this very often. It has occurred particularly when, for any reason, an artificial paralysis of the diaphragm has been produced beforehand. In such cases if the pleural adhesions are delicate, the whole half of the lung moves toward the abdomen. In that case the yielding parenchyma is compressed to a certain extent by the paraffin, but the rigid cavity is not. Later operations do not affect this condition unless in the course of months the mechanical irritation of the paraffin makes the pleura firmer and



Fig 15 Front view of same patient as shown in Figures 13 and 14



Fig 16 Endoscopic picture after complete pneumolysis

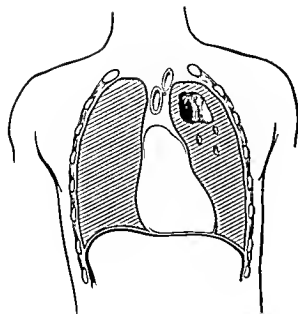


Fig 17

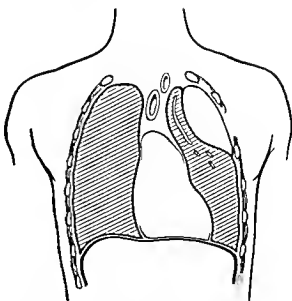


Fig 18

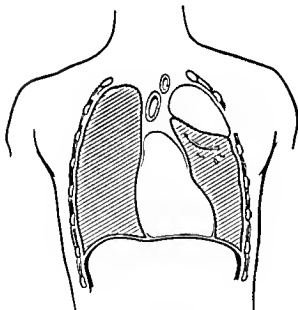


Fig 19

Figs 17 18 and 19 Sketches showing the effects of paraffin filling (plombe) on a cavity of the left lung

Figure 17 shows the cavity Figure 18 shows that the filling exerts lateral pressure from the side, Figure 19 that the filling exerts pressure from above

Often the increased density of the connective tissue in the surrounding tissue can be demonstrated roentgenologically (Figs 6, 11, 12, 13, 15, 16)

The advantage of the progressive cirrhosis for all tuberculous changes outside the cavity is obvious. But this good effect is of only subordinate importance as compared with the aid to the processes of healing which are brought about in the cavity by the paraffin. The retraction of the cavity leads to a decrease in secretion and the cleansing of the walls of the cavity even when the cavity is only partly compressed. The cleansed cavity wall is covered with epithelium from the bronchus and expectoration is reduced to a minimum. The cavity as a source of infection is obliterated.

Of course the filling is a cure only to the extent that the cavity has been obliterated, the tuberculous process must still be treated and conservative measures must be used—climatic treatment must be continued after operation.

Frequently filling of the cavity is done when total thoracoplasty cannot be carried out on account of local changes or the general condition of the patient. The results depend entirely on the condition of each patient. The operation in itself is almost free from danger, with practically no mortality for the first few weeks. Our statistics show that death occurs in only 2 to 3 per cent as a result of complications directly due to operation.

so the lung is able to offer resistance to the paraffin. If this happens the additional paraffin may later be inserted. The peculiar action which the paraffin exerts on the connective tissue of the lung and pleura produces a favorable late result. The irritation of the paraffin leading to the formation of indurations is particularly marked and valuable in the treatment of deep seated abscesses with a free pleural cavity. These same processes are seen in the filling of tuberculous cavities.

FROM THE SURGICAL CLINIC, LENOX HILL HOSPITAL

RESECTION OF THE THORACIC PORTION OF THE OESOPHAGUS FOR CARCINOMA

CARL EGGERS, M.D., I.A.C.S., NEW YORK

AT THE present time the great majority of patients with carcinoma of the thoracic portion of the oesophagus who come under observation have to be rejected for radical operation because of their poor general condition or of a local lesion too far advanced to be removable. Only a very small percentage may be directly accepted for operation, or may be put into better condition for operation by relieving complications and building them up. For these reasons progress in the surgery of the oesophagus, especially in cancer of the oesophagus, has been slow.

The results of operation in this small remaining group of cases have not been very satisfactory partly due to the fact that the operation is technically difficult and, as an occasional operation in the hands of a surgeon not thoroughly familiar with intrathoracic surgery, has yielded a high mortality, and partly due to the fact that at operation it is frequently found that the condition is inoperable.

There are certain definite reasons why surgery to date has not been able to combat this condition more successfully.

1 The patients are usually of advanced age, more often men in whom definite senile changes have taken place in other organs. They are frequently suffering from emphysema, bronchitis, myocarditis, arteriosclerosis, or nephritis. Even a much simpler operation than resection of the oesophagus in such patients would be associated with considerable risk. To subject such patients to an extensive operation which involves opening the thorax widely with the associated respiratory and circulatory disturbance is manifestly unjustifiable and can lead to no good. They would promptly succumb to shock or die as the result of a complication, either infection, pneumonia, pneumothorax, or a combination of various factors.

2 The lesion is situated in the deepest portion of the thorax where access is difficult, and where it is surrounded by vital organs, disturbance of which may lead to serious difficulty or complications. Opening of the thorax in itself involves physiological problems affecting the circulation and respiration, and steps have to be taken to

guard against trouble. Technical skill, judgment, and resourcefulness have to be exercised in all these operations.

3 Cancer of the oesophagus though formerly frequently pictured as a rather benign epithelioma has been found to be a cancer just as malignant as other types of cancer with the same tendency to spread by direct extension and along lymph channels. As it spreads through the wall it involves the surrounding structures and interferes with their function. If adhesions to vital organs, as for instance the aorta, have taken place, operative removal may be impossible. Cancer patients who have reached the stage of emaciation or cachexia are always poor risks, no matter where the primary lesion is situated. In cancer of the oesophagus this is true to a greater degree because of the surrounding vital structures and the physiological disturbance which accompanies their involvement.

4 The patients have usually lost weight when first seen by the surgeon. Unfortunately, at the present time cancer of the oesophagus is rarely recognized until it produces obstruction with the attendant nutritional disturbance and loss of weight. This factor, added to those already mentioned, adds greatly to the risk of the operation. It is well known that there are many difficulties connected with the early diagnosis of this condition and that symptoms are frequently entirely overlooked until obstruction occurs. When we realize that obstruction always means advanced disease, with all its attendant difficulties and that at this stage the lesion has become adherent to surrounding structures and is difficult or impossible to remove, then the importance of early diagnosis at once becomes apparent.

From these observations it will be noted that the first consideration in determining operability is a patient in fair general condition with a local lesion not too far advanced.



Fig. 1. Showing position of body and line of incision.

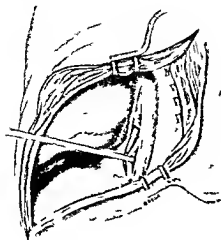


Fig. 2. Chest opened. Mediastinal pleura split and esophagus isolated.

The general condition of the patient can be determined by observation and examination, and steps may be taken to improve it.

The local condition, meaning the extent of the lesion, and whether it involves the surrounding organs or has developed metastases, can be determined only approximately in advance. Not until the thorax has been opened and the tumor actually exposed can one say with reasonable certainty that it is removable. Even then when the tumor has been almost freed one may have to discontinue the operation because separating the tumor still farther may mean certain death from hemorrhage or infection.

PREPARATION OF PATIENT

Given a patient with a carcinoma of the thoracic portion of the esophagus, a patient who seems a fair surgical risk, what is the best procedure to follow? He should be put into as good general physical condition as possible in order to be able to combat shock and infection. He must rest a great deal though he should be allowed out of bed to prevent congestion of organs. The circulation should be improved by the administration of drugs and perhaps by bathing and light massage. As there is usually loss of weight, every attempt must be made to prevent additional loss or preferably to bring about a gain in weight. This is a very difficult problem. Usually there is esophageal obstruction of some degree, and a gastrostomy should be done at once, and the patient given from 6 to 8 ounces of fluid food every 2 hours. It should consist of anything



Fig. 3. Incision of pleura above arch of aorta with isolation of esophagus at this point.

which can be given through the tube—milk, gruels, butter, fruit juices, raw eggs, beef juice, sugar, and thick cereal soups. Even then the patient often continues to lose. Everything he is able to take by mouth he should be permitted to take, as the admixture of saliva is beneficial. It will be found that after the establishment of a gastrostomy, normal swallowing will often become partially re established, and patients should be encouraged to take food the normal way as it tends to better digestion and upbuilding.

Water should be given by mouth at all times unless complete obstruction is present when it may be dangerous by producing aspiration from overflow. Water helps keep the mouth clean and also cleanses the carcinomatous ulcer in the esophagus, preventing absorption therefrom and reducing inflammatory reactions.

Considerable attention must be given the mouth in all these patients, especially those who do not masticate and have taken only milk and other fluids as they have infected deposits about their teeth. The litter must be cleaned, cavities must be attended to and mouth washes used. A clean mouth helps the immediate improvement of the patient and tends to guard against mediastinal infection at the time of operation.

The morale of the patient is usually low and a friendly, hopeful attitude toward them is of value.

Carcinoma of the esophagus is usually a slow growing lesion, and one may devote a few weeks to the preparations for operation without much danger of serious increase in the local lesion. On the other hand, if one considers that most of the lesions are quite advanced when they come under observation and show obstructive symptoms, it is wise not to delay too long before

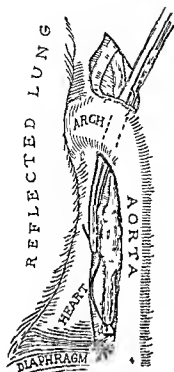


Fig 4 Double ligation of oesophagus below the tumor with cauterization of stumps

attempting the radical operation. Some improvement will usually be found with a properly functioning gastrostomy and attention to all the other measures mentioned.

The immediate preparation for operation does not differ from that in ordinary use. The entire neck, chest, upper abdomen, and left axilla have to be shaved. Feeding through the gastrostomy tube may be continued until a few hours before operation. If a residue remains in the stomach it may be evacuated just before operation. It is important that the upper oesophagus be empty to prevent aspiration. In complete or almost complete obstruction, the passage of a stomach tube down to the obstruction is advisable in order to evacuate the stagnated fluid.

A transfusion may be given if it is indicated, or at least preparation should be made for a transfusion during or immediately after operation.

A dose of morphine and atropine is given one half hour before operation.

ANÆSTHESIA

Anæsthesia has to be administered under a certain amount of pressure in order to avoid complete collapse of the lung. It is not necessary to keep the lungs fully expanded, as a matter of fact they have to be moderately collapsed in order to be able to work in the mediastinum. No special apparatus is required for this, but any

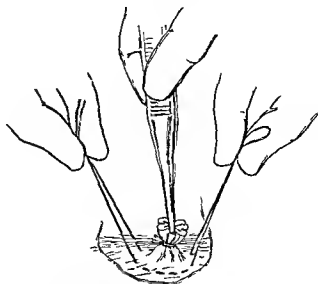


Fig 5 Showing burying of lower stump into the stomach by means of a pursestring

of the well known gas oxygen-ether machines answer the purpose. With a snugly fitting mask one may vary the intrapulmonary pressure by increasing or decreasing the pressure in the bag, and the lungs may be kept moderately inflated or completely expanded as desired. The alternating collapse and expansion is at the same time an excellent stimulant for the heart, and may be resorted to at intervals during the operation, especially when shock is threatened.

OPERATION

The method in use on our service at the Lenox Hill Hospital is one developed and first performed by Dr. Franz Terek with slight modifications which have been added from time to time as they seemed indicated. It is the first real attempt at standardization of an operation for this troublesome and dangerous condition. Several patients have recovered from the operation and others have lived sufficiently long to encourage one in believing that the operation, if carefully performed in well selected cases, promises better results than have been obtained so far. The trouble is not with the operation but with the type of patient who is usually referred for operation.

The patient is placed on his right side with the right arm elevated and flexed above the head. The left arm is also elevated and may be either fastened to the head frame or, better still, it may be wrapped in sterile towels after it has been prepared and then entrusted to the care of a sterile nurse. Having the arm free makes it possible to rotate the body as needed. The back of the patient should be fairly close to the edge

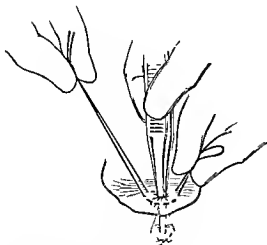


Fig. 6 Showing burying of lower stump into the stomach by means of a pursestring

of the table, as there is always a tendency to roll forward, which makes access more difficult. The right thigh and leg are sharply flexed and the left leg is kept extended. This also helps to maintain the position of the patient (Fig. 1).

As the incision is to be very long, and it is necessary to have access to the neck, the field of preparation has to be large. The entire neck, the back, anterior and lateral chest, and upper abdomen, as well as the left shoulder and arm are thoroughly cleansed with alcohol and ether, and the area is then painted with half strength tincture of iodine. Sheets are applied in such a way that the arm projects and may be moved into any desired position, carrying along the scapula.

The incision runs midway between the spine and the posterior border of the scapula over the fourth, fifth, sixth, and seventh ribs and is then carried forward along the entire length of the seventh intercostal space. The muscles are then likewise divided. During this part of the operation many blood vessels are encountered and it is well to take time to ligate them all to avoid the loss of blood. The posterior ends of the four exposed ribs are now quickly divided, care being used to control bleeding from the intercostal vessels which may be quite troublesome. A good method is to use a strong curved needle with a double plain catgut suture and to catch muscle fibers together with the vessels. The pleura is now opened along the entire length of the incision. Frequently it is best to make the long intercostal incision first, spread the ribs apart as much as possible, and then, with a finger under the ribs as a guide, divide the seventh, sixth, fifth, and fourth ribs. This method is helpful in

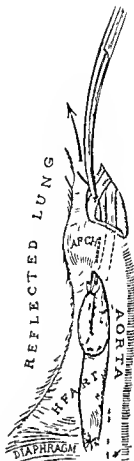


Fig. 7 Esophagus has been divided. Upper end with tumor is being drawn upward behind the arch of the aorta

controlling bleeding from the posterior ends of the intercostal vessels.

A rib spreader (a Balfour self retaining abdominal retractor serves this purpose well) is now inserted and the entire thoracic contents are exposed for inspection. By this time, unless pleural adhesions are present, the lung has collapsed somewhat and by gently displacing it forward the field of operation comes into view (Fig. 2). The aorta is the most prominent and is easily recognized by inspection and palpation. To the right of it the esophagus is situated in the mediastinum. It can not be seen and neither can one feel it unless a large tumor which has involved the surrounding tissue acts as a guide to it. But such a case would be inoperable. To expose the esophagus, an incision is made through the mediastinal pleura from the diaphragm to the under surface of the arch of the aorta. Without much difficulty the uninvolved portion of the esophagus can then usually be

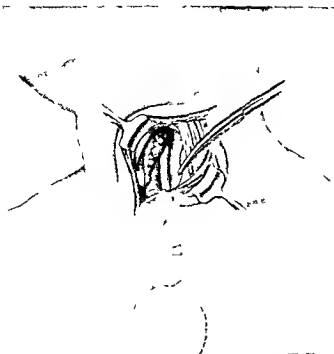


Fig 8 Oesophagus has been isolated in the neck and is being drawn out of the wound together with the tumor

isolated by blunt dissection with the finger. A tape is placed around it and gentle traction then enables one to pass the finger upward and downward in an attempt to free it completely and to palpate the suspected tumor.

Great care must be used doubly to ligate and divide all small vessels encountered, as bleeding with the attendant tissue infiltration obscures the picture and increases the difficulty. All cases which have come to operation at our hospital have had involvement of all the coats of the oesophagus, with adhesions to the surrounding structures. Whether in the face of extensive adhesions the operation should be continued must depend on the judgment of the individual surgeon. Patience and careful dissection will accomplish a great deal. If it is found that the tumor involves the wall of the aorta, it is evidently useless to proceed. On the other hand, adhesions to a bronchus or the opposite pleura have been successfully handled. Separating the tumor from its bed is always difficult, especially if it is situated behind the arch of the aorta. Vagus fibers have to be sacrificed and branches of the aorta may have to be divided to gain access. Should the opposite pleura be accidentally opened, a moist pack will temporarily avoid respiratory embarrassment. Later an attempt may be made to close the opening or one may succeed in re-establishing two pleural sacs by suture of the left pleura overlying the mediastinum. After com-

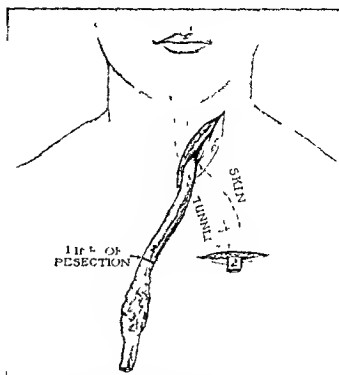


Fig 9 Skin tunnel has been made from the lower end of the neck wound to about the region of the second intercostal space where a transverse incision has been made to which the oesophagus stump will be sutured

pletely freeing the oesophagus with the tumor, below and behind the arch, an incision is made in the pleura extending from the arch to the dome of the thorax (Fig 3). With the finger the oesophagus is likewise isolated here, perhaps aided by a finger or curved clamp passed upward from below and behind the arch. These various manipulations produce considerable shock which at times is quite alarming. The best way to overcome it is to interrupt the operation from time to time for a few minutes and to use the interval to bring about complete expansion of the lung. We usually remove the rib spreader, take all pads out of the thorax, except perhaps one in the tumor bed, place a moist pad over the wound, and instruct the anesthetist to increase the pressure and administer oxygen. The patient's color at once improves and respiration and circulation recover from the temporary depression. The next step in the operation is doubly to ligate the oesophagus below the tumor and to divide it with the electric cautery or a paquelin (Fig 4). We use heavy silk or narrow tape, as finer material is likely to cut through. The ligature on the upper stump is left long. The lower stump is inverted by a silk pursestring suture in a similar manner that one hurnes an appendix stump (Figs 5 and 6). If there is



Fig 10 Oesophagus stump has been united with the gastrostomy by means of a rubber oesophagus

room a second pursestring is placed and the stump is completely imaged into the stomach, otherwise one places a few interrupted sutures better to secure the first pursestring. Attention is now directed to the upper end. By means of a forceps passed from above behind the arch of the aorta, the long ligature which had been left on the upper stump is grasped and the oesophagus with the tumor drawn upward until it emerges above the arch (Fig 7). It is then wrapped in moist gauze and by blunt dissection easily freed upward as far as the neck.

On completion of this part of the operation, the thorax is temporarily partly closed, towel clips being used for approximation of the skin edges, and the patient is turned on his back. During these manipulations it is difficult to maintain proper asepsis, and great care must be used. At this stage the value of having the left arm free and in the care of a sterile nurse becomes apparent. The left side of the neck is now exposed and may have to be prepared a second time. An incision about 3 inches long is made along the anterior margin of the left sternocleidomastoid muscle. The large vessels are retracted outward and

usually without difficulty the oesophagus can be isolated (Fig 8). This is of course easiest if the dissection from below has been carried high. In case difficulty is experienced it may be necessary again partly to turn the patient, and with a hand inserted from below, aid in the identification of the oesophagus. As soon as it has been completely freed it is drawn out of the neck wound, wrapped in moist gauze, and temporarily left there.

The patient is then again turned on his side, and the chest reopened. By means of a continuous plain catgut suture the pleural margins are united from the dome of the thorax to the arch of the aorta. This can usually be done without difficulty. The neck wound is thus shut off from the pleural cavity and entrance of air is avoided. A similar procedure is followed with the pleural edges below the arch. It is wise at all times to suture this portion of the pleura in order to cover the mediastinum, but it is especially valuable in patients in whom the opposite pleura has been opened, as by this means two pleural cavities are re established.

In case drainage of the thorax is advisable, a stab wound is made posteriorly through one of the lower intercostal spaces and a half inch soft rubber tube is inserted for a distance of about 3 inches. It should have an end and a lateral opening and be fastened to the chest wall by means of a suture passed through a rubber cuff.

The lung should now be fully inflated and closure of the thoracic wound begun. A few heavy chromic catgut sutures are passed around the opposing seventh and eighth ribs and used for approximation. The ends of the divided ribs fall into apposition without difficulty. The parietal pleura usually can not be sutured separately and it is not necessary to attempt it. A running plain catgut suture will approximate the intercostal tissues and with them the pleura, but the wound will not be airtight until the various muscle layers of the thoracic wall are likewise united. Interrupted chromic catgut is best for this purpose. The skin is closed with interrupted silk, or in case haste is imperative, with a continuous plain catgut. During all this time it should be the aim of the anesthetist to keep the lung inflated as it helps the general condition of the patient and prevents a pneumothorax. A dry dressing is applied, sealed with adhesive plaster, and the patient is turned on his back, and after making sure that the lung is fully expanded the drainage tube is clamped.

Attention is now directed to the neck wound and the projecting oesophagus. After retracting

the skin edges, the muscles are closed around the oesophagus without making any undue pressure. A subcutaneous tunnel is then made by blunt dissection from the lower end of the neck wound downward usually to the level of the second intercostal space and a transverse incision made at its lower end (Fig 9). The oesophagus with the tumor is drawn through this tunnel and out of the lower incision where it is sutured to the skin margin with interrupted silk. The projecting portion containing the tumor is then removed with the cautery. The stump must be left open to permit the free discharge of saliva. The neck wound is closed with silk and a dry dressing applied.

AFTER-TREATMENT

After the patient is returned to bed, the drainage tube is inserted into a bottle on the floor with its end under a fluid level, which effectually establishes a closed method of drainage.

Measures to counteract shock are instituted as indicated. Hot water bottles are applied to the body, a hot coffee enema of 6 ounces is given containing one ounce of whiskey and grains 1/15 of strychnine. Cardiac stimulants have usually been given during the operation and are continued as the condition of the patient seems to require.

In case there has been much loss of blood, a transfusion is given. Morphine is administered in small quantity at regular intervals to relieve pain and to quiet respiration. It is of great value.

During the first 24 or 48 hours, water is given by hypodermoclysis under the skin of the thighs or by proctoclysis. After that it is given through the gastrostomy tube, at first by the drip method and later in gradually increased fixed quantities at regular intervals. In case it was not possible to get a good inversion of the oesophagus stump into the stomach, and leakage is feared at this point it is best to delay administration of fluids into the stomach a few days longer. Nourishing fluids may be added or substituted for the water as soon as the condition warrants it, about the same as in ordinary postoperative cases.

In addition to the removal of the carcinomatous lesion of the oesophagus, one of the aims of this operation is the re-establishment of the function of deglutition. As the greater portion of the oesophagus has been removed, a substitute has to be found, and a rubber tube has been used for this purpose very successfully. Unless there is disturbance of healing with the neck wound or around the oesophageal fistula, the patient may be encouraged to swallow saliva and fluids a few

days after the operation. All fluids so swallowed naturally flow out of the fistula and have to be caught in a basin. Patient is then given food to masticate and swallow and when the function is well established a rubber oesophagus is inserted into the fistula and connected with the gastrostomy tube below (Fig 10). The tube is armed with a rubber cuff about 2 inches from its upper end, which makes it fit snugly against the oesophageal opening after insertion. A pin is fastened in the cuff and by means of a tape passed through it and around the neck the tube is held in place. To avoid leakage during deglutition, the patient makes light pressure with his fingers over the oesophagus on either side of the tube. He masticates his food thoroughly, and then swallows it the normal way, the food passing through the pharynx, upper oesophagus, and then through the rubber oesophagus into the stomach. A little more fluid is required than for people with a normal oesophagus. Between meals the tube may be withdrawn from the oesophagus and closed with a cork, or it may be left in place, as the patient desires.

For comfort a bed which allows elevation of its upper end is desirable, as patients usually breathe better and feel more comfortable in that position. We use Gatch beds for these patients. As soon as the condition permits, patients should be encouraged to sit out of bed.

No special attention is required for the external wounds. If they remain clean and heal by primary union the sutures are removed on the seventh or tenth day. The sutures holding the oesophagus stump have to be left a little longer to prevent retraction. Physical signs, a bedside X-ray examination of the chest, a record of the pulse and temperature, and the amount of drainage through the tube, all will give an indication of the intrathoracic condition. If the lung remains well expanded, and the amount of drainage is slight, decreases daily, and is not badly infected, the drainage tube should be removed and discontinued. If a real infection develops, on the other hand, drainage has to be continued and the patient treated as a regular empyema case. In the weakened condition of these patients, such a complication would have to be considered a very serious one.

Complications resulting from disordered function of the heart and kidneys are best avoided or overcome by the treatment already outlined. One has to be constantly on the alert to support the patient in whatever way seems indicated.

From the description of this operation it will be apparent that it is of considerable magnitude

and that it would place a strain on even a normal person. The importance of early diagnosis is therefore evident and the point must be stressed that patients have to be referred for operation before their resistance has been lowered by under-nourishment and carcinomatous cachexia, and the local lesion has progressed to a stage where it interferes with surrounding vital organs and makes operative removal impossible.

It is well known that there are many difficulties connected with the early diagnosis of this condition and that symptoms are frequently entirely overlooked until obstruction occurs. It should

always be remembered that slight disturbances of deglutition may mean an early oesophageal carcinoma and therefore proper, thorough examination should be made at once. Only in this way can we hope to treat patients early enough to secure the maximum benefit and avoid waiting until, as at present, the great majority are found to be inoperable on first examination and only in an exceptional case can operation be done successfully. There is reason to believe that in properly selected cases this well standardized operation will obtain a larger percentage of recoveries than has been the case so far.

CONGENITAL CYSTIC DISEASE OF THE LUNG

I. I. LOESSLER, M. D. SAN FRANCISCO

From the Department of Surgery, Stanford University Medical School

THE scant number of congenital cysts of the lung reported in the American literature justifies the addition of this series. I have been able to find but four American observations: two of R. T. Miller, a description of an anatomical specimen by Pappenheimer of New York, and one of my own. The German and French literature is fuller. The picture of this disease, so striking in both its clinical and pathological aspects, has received considerable attention from German authors.

Congenital cysts of the lung occur in two forms: one the solitary cyst, and the other cystic degeneration proper with a more or less diffuse cystic degeneration of larger or smaller parts of the lung. The two forms may co-exist, which was the condition present in my first case.

Solitary cysts may lie within the parenchyma of the lung, they may occupy the site of a whole lobe, they may sprout from other organs to which they are developmentally attached, e.g., the trachea or the esophagus, they may even have been displaced by congenital malformation into an extrathoracic position, thus a cystically degenerated accessory pulmonary lobe has been found in the upper abdomen.

Clairmont reports a congenital cyst of the right middle lobe in a boy of 10 which had no communication with a bronchus. The cyst contained pus and was at first mistaken for an interlobar empyema. The temperature reached 39 degrees and the X-ray films might well be interpreted as depicting an interlobar effusion. At operation, however, the pus was found lying not next to the thoracic wall but centrally, so that it was necessary to traverse lung tissue in order to reach it. Later, after the lung had retracted, it was apparent that the cavity had an epithelial lining with what seemed to be a bronchus debouching into it. This circumstance established the diagnosis. Although very little air was expelled from the cavity, touching it provoked no cough and there was no expectoration either of blood or mucus. The boy died some 14 months later following an attempt at extirpation and closure. At autopsy the remains of the cyst were found in the right middle lobe, it was lined with cuboid bronchial epithelium. Sauerbruch, Sultan, Gold, Rach, and others report similar observations. One of my own follows:

CASE 1. Mr. P. S., a retired saloon keeper of 60, who had had occasional attacks of cough and fever thought by him to be "grippe," consulted Dr. Arthur Sonnenberg for bleeding from the rectum. The patient had paid no attention to his cough and had never had sufficient trouble with his chest to see a doctor for it. Examining the chest as usual before beginning the gastro-intestinal roentgenography for which the patient was sent to him, Dr. Rehfish was struck with an annular shadow at the bottom of the right chest and took films, reporting as follows:

Fluoroscopically the diaphragm moves well and equally on both sides and the posterior mediastinum is clear. There is a delicate lineal shadow near the right base which marks off anteriorly a segment of lung which suggests a possible cystic middle lobe. On the contrary, however, this may be only a markedly fibrous interlobar septum. There is also a little fibrous trabeculation at the left base where the appearance suggests possible congenital cyst at the base of the left lower lobe. The upper two thirds of the lung fields are clear, and the heart and aorta are within normal limits of size and shape."

A possible diagnosis was made of congenitally cystic lung.

The bleeding proved to be due to rectal polyps and was relieved by Dr. Sonnenberg's treatment. Knowing of my interest Dr. Sonnenberg kindly allowed me to examine his patient. The right chest of this pale, not very well preserved old man was distinctly although not greatly retracted and moved less than the left. There were basal crepitations on both sides but no changes in breath sounds and no difference in resonance. The apices were perfectly free.

On the 8th of May lipiodol was injected. Dr. Rehfish reported "Approximately 20 cubic centimeters of lipiodol were injected into the right base. The injected bronchi are very interesting in that they almost completely surround the thin walled cystic sac in the right lower lobe. Their relation to this cyst is beautifully brought out in the stereoscopic views. The small peripheral cyst at the costal diaphragmatic angle is also clearly made out, though unfortunately here too no oil entered the pathological focus."

Bronchoscopy was not done, nor was the patient treated for his cyst, he having no symptoms to warrant it.

There is no doubt of the congenital origin of these solitary cysts.

The second form, cystic disease proper, variously termed congenital bronchiectasis, "honey-comb lung," saccular degeneration of the lung, etc., is possibly more frequent than the solitary cyst. Meyer and later Grawitz described the pathological anatomy in some detail. In this form, a whole or a part of one lobe, or even a whole lung itself may show various degrees of cystic degeneration, ranging from multiple miliary cysts scattered through a normal parenchyma to conversion of a lobe or of a whole lung into a huge multilocular or unilocular cystic sac (Case 2).



Fig 1 Case 1 Anteroposterior view of large cyst at right base



Fig 2 Case 1 Lateral view of large cyst at right base

Mild degrees of cystic degeneration accompanied usually by more or less atelectasis have been repeatedly described by pathological anatomists and are depicted in many textbooks. In their early stages, at least, they elude clinical recognition. More pronounced cystic changes with saccular or clubbed dilatation of the bronchial endings are subjects of controversy. Some authors follow Grawitz in considering most of them congenital, others consider them acquired.

They may be present at birth or in the first few months of life. Heller, Orth, and others think that they are due to a persisting fetal atelectasis in which the expanding thoracic cage, finding no yielding alveolar tissue upon which to exert its expansive force, expands the bronchi instead.

Sauerbruch, Kussling, and Borst consider congenital cystic disease much more frequent than is ordinarily assumed. Heubner, the Nestor of German pediatricians, Wiese, and most German pathologists consider that bronchiectasis is rarely congenital. The problem is difficult, for the history of acute respiratory infection, such as pneumonia following measles, which is often adduced as the cause of a saccular dilatation of the bronchi, speaks neither for nor against the

question of congenital versus acquired origin. Respiratory infection may not be a cause but merely the factor which, changing an aseptic and symptomless cystic lung into an infected and suppurating one, makes disease manifest. Cysts themselves may cause no symptoms. So long as they are uninfected their carrier may be unaware of their presence. It is suppuration that makes the disease. Sauerbruch remarks in this connection "what we are accustomed to look upon as the cause of bronchiectasis, chronic recurrent catarrh, is already the expression of suppuration in the cavities."

While it may not be possible to establish a congenital or acquired origin in every given case, pathological anatomy has brought out facts that make the congenital origin of some dilatations at least certain. Thus cystic dilatation of the bronchi has been found in the newborn and in the fetus. Grawitz distinguishes two congenital cystic anomalies, a universal bronchiectasis in which a main bronchus and all its side branches are dilated so that the main one forms a large cyst with many small cysts debouching into it, and a telangiectatic bronchiectasis in which the smaller bronchioles are cystically dilated, the dilatations sometimes



Fig 3 Case 2 Before operation A large unilocular cyst occupies the left upper lobe multiple cystic pouches filled with lipiodol occupy the left lower lobe The heart and mediastinum are much displaced to the left and the left side of the chest is much retracted

being open, sometimes closed, sometimes strung one after the other on the thread of an occluded bronchus, like beads on a rosary

In these two forms of multilocular cystic disease Sauerbruch and Lotzin have found that congenital bronchiectasis frequently presents an irregular conglomeration of cysts, some without connection with the bronchial tree, that these cysts are lined with a single layer of ciliated epithelium, and that the wall is usually free of ulceration or inflammatory deposits. In the congenital form the cystic areas are free of carbon and inhaled pigments, in the acquired form pigment is not wanting and the bronchi are inflamed and ulcerated

The congenital origin of the most marked degrees of sacculation admits of no doubt

CASE 2 A young student of 20 years was referred to me by Dr James W Ward in 1927. There was no lung trouble in the family. The boy had had all the ordinary diseases of childhood measles, whooping cough, scarlet fever, and frequent sore throats. Before his present illness he had his tonsils removed, since then he has had no further trouble with his throat. As a child he had a lymphadenitis and lymphangitis of the arm following an injury which laid



Fig 4 Case 2 After operation The large cystic pouches are filled with lipiodol introduced through wound

him up for 7 weeks. He recovered from all of these infectious ailments with no difficulty, none of them affected his chest

In 1917, at the age of 9 years, he had what was thought to be a pneumonia that lasted 6 weeks, with it he had a constant cough but no expectoration. The pneumonia was thought to have been followed by an empyema. Since this illness he has had an attack of fever about every 6 months. His chest was aspirated periodically and finally was opened by Dr Ward in 1920 much pus being evacuated

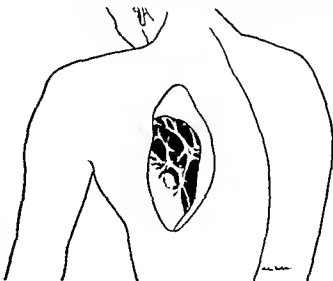


Fig 5 Case 2 Cysts of lower lobe opened



Fig 6 Case 3 Much retracted, uniformly gray left chest

The chest has remained open ever since he wears a drainage tube in it. Bismuth paste was injected into the opening a number of years ago. He promptly coughed out the paste.

He is very thin and dyspnoeic on exertion but he feels fairly well except for his chest. I first saw him for a short visit on September 12, 1927. He was a lad of about 6 feet 2 inches in height, he weighed about 110 pounds. The pulse was 60, the blood pressure 120-80, there was no rise in temperature.

The cervical and axillary glands were moderately enlarged and soft. The skin was of the pale greenish hue of chronic sepsis. The thyroid was about one and one-half times normal size, soft and of uniform consistency.

The chest was flat, the left side was retracted and stood still. It was tympanic upon percussion. There were no breath sounds to be heard over it. There was a drainage tube inserted into a small opening in the tenth rib at the line of the scapular angle. There was very little secretion from the tube. Air escaped from the drainage opening when he breathed or coughed and a few drops of ether injected into it immediately provoked a cough. The right side of the chest was free, there were no rales at either apex.

The heart was displaced 1 inch to the left of the left nipple line, the right border lay $\frac{1}{2}$ inch to the left of the sternum. The liver and spleen were not enlarged and not palpable, the rest of the abdomen was normal. There was no oedema. The urine was normal. The blood count was as follows: haemoglobin 85 per cent (Sahli), red blood cells 5,080,000, white blood cells 7,800, polymorphonuclears 68 per cent, lymphocytes 32 per cent.

Dr. John Rehfish reported that the X-ray examination showed the following: Chest (October 11, 1927)—fluoroscopically, the left diaphragm cannot be distinctly made out though its dome is more or less well outlined by a gastric air bubble below. It does not move. The right diaphragm is hyperactive. Stereoscopic anteroposterior chest films

show a very marked collapse of the left lung with a large pneumothorax occupying practically the entire upper half of the left chest. The lower lobe would seem to be not so well collapsed. It is densely atelectatic and the bronchial tree supplying it which is air-containing can be well made out below the heart shadow. This is especially well demonstrated when the plates are viewed stereoscopically. A portion of the tenth rib has been removed posteriorly and a drainage tube is inserted through this bony defect into the lower portion of the left chest just above the diaphragm. There is no fluid present. The heart and mediastinal contents have been displaced toward the left and much of the hilus shadow of the right lung lies behind the vertebral column. The right lung itself appears normal so far as active pathology is concerned. There is a small calcified nodule at the right top. The roentgenographic conclusion was: Drainage tube in left chest with complete collapse of upper lobe and partial collapse of lower left lobe.

Lipiodol injection of chest (October 12, 1927)—Fluoroscopically the lipiodol is seen to be partially obstructed just below the point where the left major bronchus takes origin. A considerable amount of oil drips slowly down past this point and enters a small bilocular puddle with its lower margin at the summit of the dome of the diaphragm. This puddle has a clearly demonstrable connection with two large bronchi and its bronchial relations are beautifully demonstrated in the stereoscopic films.

The lateral view shows that this bronchiectatic puddle is very near the dorsal border of the left base. When the patient raises his intrathoracic pressure voluntarily the oil is forced upward and out of the drainage tube.

From this examination it was concluded that there was a stenosis of the left lower bronchus with peripheral bronchiectatic dilatation in the partially collapsed lower left lobe with a bronchial fistula connecting it to the outside.

I diagnosed a chronic empyema with a bronchial fistula, and thought it most likely that we had to deal with a congenital bronchiectasis that had perforated into the chest. I advised an attempt at closure after the manner of Colonel Keller.

I may as well state here that both Dr. Rehfish and I were mistaken. What we took to be a large pneumothorax cavity was not a pneumothorax, but a huge unilocular cyst of the left upper lobe. The left lower lobe was not collapsed, but consisted of a series of bronchiectatic cysts, and the drainage tubes lay in one of these cysts and not in the pleural cavity.

On October 20, 1927, under satisfactory gas and local anaesthesia, a curved incision was made over the left chest and about 3 or 4 inches of three ribs including two below the one which had grown around the drainage tube and this rib itself were resected. Upon opening the pleura one entered a sacculated multilocular cavity into the top of which an open bronchial mouth debouched. The upper part of the chest, which from the radiographs seemed to consist of one large pneumothorax cavity, was now seen to be closed from the present thoracic opening by the above mentioned sacculated membrane. The pericardium lay at the front of the wound. The soft parts were brought down over the pericardium with one mattress stitch and the rest of the wound was left open, the sacculated cavity being packed with balsam of Peru gauze. It appeared probable that the cavities were bronchiectatic.

The boy made a good recovery.



Fig 7 Case 3 Left chest injected with lipiodol which has puddled in the cystic cavities. The mediastinum, the trachea, and the heart are much retracted to the left, the left diaphragm is high.

On November 7, 1927 my notes read: "The old cavity exposed at previous operation, is clean and granulating. The pericardium is visible in the bottom of it and between it and the chest wall lies a trabeculated meshwork into the pouches of which various bronchi debouch, touching these bronchi immediately provokes a cough. Access to the upper part of the pleural cavity which radiographically seems to consist of a single large space is not got by this first operation, a needle introduced into the upper chest in two places withdraws air. In order to open the upper part of the chest, therefore $2\frac{1}{2}$ inches of two more ribs are resected from about the costal angle forward. The underlying parietal pleura is about $\frac{1}{4}$ inch thick underlying it and clearly separable from it in a cleavage plane is another thin membrane, perhaps $\frac{1}{2}$ inch thick. When this is entered one looks into a large cavity, occupying the whole upper chest, gray and glistening its medial surface pierced by numerous openings, the largest perhaps $\frac{1}{8}$ inch across some of them running as tunnels superficially in and out of the thin membrane, others probably running toward the bronchi. Between this very large cavity and the multiple trabecular ones, opened at the previous operation lies a thin, but tough fibrous septum perhaps a little over $\frac{1}{4}$ inch thick, which in its center clearly carries a little spongy lung tissue. This septum runs on to the chest wall and completely separates the newly opened very large upper cavity from the small trabecular ones opened at the first operation. Diagnosis: congenital maldevelopment, left lung. Bronchiectasis of lower left lobe, and enormous bronchiectasis of left upper."

After about a week the drainage tube was removed from the large cyst of the upper lobe, the opening closed and no further fluid collected in it. The trabecula of the lower



Fig 8 Case 3 Lateral projection of cystic cavities filled with lipiodol.

lobe shrank in the course of the patient's 2 months' stay in hospital leaving exposed the large, shallow, half-opened pouches that represented the open cysts of the left lower lobe. They were lined with a velvety, red, bronchial mucosa. Touching them provoked no cough, but the large lumina leading toward the hilum were extremely sensitive, so that touching them with an instrument sent the patient into fits of coughing. The pouches secreted a clear, thick, viscid mucus.

On January 24, 1928, the sacculated and open lower lobe was dissected off from the pericardium and diaphragm to which it was attached partly with a knife partly with the galvanocautery. A thin layer of alveolar parenchyma surrounded the large pouches. At the end of dissection two large bronchial branches led into the left lower main bronchus. These were cut across, the vessels of the hilum were tied, and the bronchial mouths closed with fine black silk sutures. The soft parts, the skin, and the subcutis were loosened, dropped in over the bronchial stump and loosely united with silk-worm gut sutures. A transfusion was done on February 7.

The boy again made a good recovery and on March 12 was sent home with a small sinus leading to the stump of the left lower main bronchus which still secreted a few cubic centimeters of mucus a day. Since he has been at home a few black silk sutures have been discharged from the sinus. A lipiodol injection shows it to lead into the left main bronchus. No connection between the large cyst of the left upper lobe and the sinus is demonstrable.

The boy has been at school for two and a half years. A minute bronchial fistula discharging a few drops daily still persists. The upper cavity has given no trouble and remains empty. The lad although free of fever and sepsis is still much underweight.

Although the single sacs were smaller, sacculatation was equally extensive in the following case:



Fig 9 Case 4 Collection of annular shadows (cysts) at base of left lower lobe

CASE 3 Pa quale M, an Italian bootmaker, 20 years of age, entered the Tuberculosis Department of the San Francisco Hospital in Dr W. R. P. Clark's service on April 15, 1929. He complained of a dry cough of 1 week's duration which troubled him most at night. Four days before entry he had brought up perhaps a tablespoonful of bright blood. Except for this recent complaint he had considered himself perfectly well and healthy.

He was a thin young man in no distress. The chest was thin, poorly clothed; its movements were restricted on the left side. The heart was markedly displaced to the left. The apex of the left lung was dull and the fremitus was increased here but diminished at the left base. Over the whole left side the breath sounds were diminished and there were many rales. The right side was free. Bronchoscopy by Dr Tillotson¹ revealed a narrowing of the left main bronchus beyond which the instrument could not be passed. The carina, instead of occupying the normal anteroposterior position (vertical in appearance as viewed through bronchoscope with patient lying on back) occupied an oblique position. The relative diameter of the upper or left main bronchial orifice was much smaller than that of the right and presented in its upper portion a slightly granular appearance, not reddened or bleeding on touching as would suggest true granulation tissue. The orifice of the left main bronchus was too small to admit the tip of the 7 millimeter bronchoscope. No free secretion was noted coming from this orifice. On passing the bronchoscope along the right main bronchus a small apparently anomalous bronchial orifice was noted in its left lateral wall at less than 1 centimeter from the carina. On subsequent lipiodol injection this appeared from the X-ray film to communicate with the left main bronchus. The upper lobe



Fig 10 Case 4 A lateral view of the cystic cavities some of which lie behind the heart and are apparently filled with fluid

bronchial orifice on the right and the orifices of the middle and lower lobe bronchi on the right were identified and appeared normal. No free secretion was encountered in the right main bronchus. No granulations or ulcerations of the mucosa were noted. A No. 12 rubber catheter was introduced through the bronchoscope to the left main bronchus after which the bronchoscope was withdrawn and the catheter left *in situ*. The patient was moved to the fluoroscopic room and lipiodol was introduced through the catheter with a Luer syringe, the distribution of the oil being observed under the fluoroscope. X-ray plates taken in the anteroposterior and lateral planes are shown in Figures 7 and 8.¹

The following report on the X-ray plates was given by Dr. Rehfisch:

'There is a very satisfactory lipiodol injection of the posterior portion of the collapsed left lung. The lipiodol is gathered in small puddle like masses demonstrating the presence of a grapelike cluster of bronchial dilatations. In view of the total absence of clinical evidence pointing toward true bronchiectasis, the possibility of a cystic dilatation of the bronchi must be strongly considered.'

On June 8, 1929, bronchoscopy was repeated. The appearance of the tracheobronchial tree open to inspection through the bronchoscope, was the same as at examination May 21, 1929, with the exception of the fact that the granular contour of the upper portion of the left main bronchial orifice was not noted in this examination.

The patient was free of fever while in the hospital. No tubercle bacilli were found in the sputum. The Wassermann reaction was negative.

Multilocular cystic disease involving but a portion of the left lower lobe was found in the following patient:

¹Reported by Dr R. S. Tillotson, California & West Med., 1929, xxxi, No. 6.



Fig 11 Case 4. A little lipiodol has been injected into the cysts. It puddles at their bottom.



Fig 12 Case 4. Lateral view after lipiodol injection.

CASE 4. Francis B., a robust young man of 23 years, was referred by Dr. S. with a request for an opinion. The young man had asked for Dr. S.'s daughter in marriage but Dr. S. upon inquiry found that Mr. B. had a cough. He considered himself perfectly well and fit, had worked hard as a rancher and had spent some time at Stanford University where he trained on the football squad. He related that at the age of 12 years while putting his shoulder to the wheel of a mired wagon he suddenly began to cough and after this was laid up for 3 weeks with cough and sputum. He does not remember whether he had fever. He knows of no reason for his illness. There is no history of aspiration of a foreign body, of pneumonia, or other assignable cause. He was brought to Oakland under the care of Dr. von Adelung who tapped the chest at various points and finding pus drained it. The tube was removed after a few weeks, and the boy returned to his ranch in Lake County. The cough stopped, but returned some 3 years later. Since then he has coughed more or less and can always produce sputum, as he says, by standing on his head. For a time he could not lie on the right side, but he is now able to do so.

The patient was a robust, healthy looking boy of 22 years. The forehead projected unusually far above the nose, and on blowing his nose he produced some dry scabs. The tonsils were not inflamed, the teeth were good, the cervical lymph nodes were about the size of beans. The axillary glands were not enlarged.

The left shoulder was higher than the right, but the respiratory movements of both sides were almost equal, if not entirely so. There was the scar of the above-named drainage operation in the left lower chest, between the posterior and anterior axillary lines, with coarse ridges here.

Put on the table and made to lean forward with his head over the edge and his body down, the patient immediately brought up nearly half an ounce of foul, almost entirely purulent sputum which contained some small inspissated chunks. The chest is otherwise negative, in particular, the apices are free.

The abdominal organs gave no evidence of abnormality.

I advised that pictures be taken of the chest and sinuses. I considered it likely that this boy was still harboring the remains of an empyema on his left side.

X-ray report. The heart vessel shadow is normal in size and position. The hilar markings are heavy and the pulmonary tree markings radiating into the left lower lobe appear as curious, whorled streaks. These are strongly suggestive of large, thick-walled cysts or cavitations. In a lateral view a somewhat horizontal line of density is noted at the left base posteriorly.

Examination of the sinuses showed a very light degree of grayness in both maxillaries and frontals (the latter being rudimentary). This is indicative of slight, chronic mucous membrane thickening. The anterior ethmoidal cells appeared a little gray. The peculiar, cyst-like cavitation throughout the left lower lobe, without evidence of pneumonitis or infiltration, led to the conclusion that the patient was probably suffering from chronic, basal, pleural thickening with possibly a little fluid.

On October 26, 1929, an X-ray picture was taken of the chest after injection of lipiodol. The main bronchi entering the left lower lobe appeared normal. Two large cavities were seen with a little lipiodol in their inferior portions. Five small sacculi were also seen.

After consultation with Dr. Eloesser, it seemed strongly probable that there was a congenital, cystic condition of the left lower lobe, there being at least three large cyst-like areas with several small ones.

The sputum contained masses of pus cells and varied organisms, with morphology and staining characteristics of bacillus pleurificus and micrococcus catarrhalis, as well as a few chains of streptococci, but no tubercle bacilli.

I considered operation not warranted in view of the mildness of symptoms.



Fig. 13. Case 5. Lymphangioma of mediastinum.

The foregoing observations represent the various kinds of cystic disease—the solitary cyst and multiple cystic degeneration of various degrees and extent.

Missing from my series are observations of cystic disease in infants such as Miller reported. The infantile disease is characterized by sudden attacks of intense dyspnea and cyanosis. Some of these attacks may possibly be caused by a spontaneous pneumothorax (although one is inclined to inquire what makes these lungs rupture), but most of them are caused by a sudden inflation of the cystic lung. Spontaneous pneumothorax has been observed at autopsy (Wiese), but how air entered the pleural cavity of the stillborn infant upon whom autopsy was performed does not appear. Miller's films and other observations denote rather a sudden hyperinflation of a cystic lung with displacement of the mediastinum than a pneumothorax. The thin walled cysts usually have a narrow bronchial outlet, crying or struggling entraps air in them as forced breathing entraps air distal to any partial bronchial stenosis, greatly raising intrapulmonary pressure, deflecting the thin mediastinum, and compressing the sound lung. It is this sudden compression of the sound lung by the dilated cystic one that causes the sudden attacks of dyspnea and cyanosis characteristic of the disease in infants.

A case of lymphangioma simulating in some particulars cystic disease I owe to the kindness of Dr. George D. Lyman, who will report it in full

The boy when seen on June 5, 1928, was 8 years old. When he was an infant of a few months he was examined by Dr. Lyman who noticed a swelling in the clavicular region he thinks the left which came and went so that he thought of a herniation of the lung. The child was X-rayed by Drs. Ruggles and Bryan who reported a lung hernia coming through the first intercostal space. At the same time there was seen on the left side of the mediastinum a round globular mass. The child was subjected to X-ray treatment the swelling above the clavicle disappeared and no further symptoms of intrathoracic trouble made themselves apparent. Therefore no further X-ray pictures were taken and the child apparently developed in a perfectly normal manner. His tonsils were removed several years ago under general anesthesia without ill effects. His father however thinks that he noticed when the child laughed or cried that a swelling appeared above the right clavicle about the size of a fingertip.

About a month ago the boy had an attack of mumps and Dr. Lyman who examined the neck at this time on account of the large swelling of the parotid was quite sure that no noticeable mass was present in it. About 10 days ago after the boy had been in swimming a lump made itself apparent above the right clavicle this lump has increased so rapidly in size that there is considerable variation from day to day.

The boy has had bronchitic attacks not infrequently with some cough and perhaps a little wheezing on exercise the latter, however is not certain. Otherwise he is perfectly well and healthy.

The boy is well developed. Above the right clavicle there is a soft movable mass twice the size of a hen's egg which swells up to perhaps one eighth of its size larger when the child coughs. It is encapsulated and cannot now be dislocated at all below the clavicle although Dr. Lyman states that on first feeling it and when it was smaller part of it could be caused to disappear into the chest by pressure. The mass is not at all tender the skin above it is not changed. The right jugular is a little more prominent than the left and the veins of the skin are slightly more prominent on the right. There is no cyanosis of the arms and no stridor. Distinct from the swelling there is another one biscuit shaped lying under the right trapezius muscle from which it may be dislocated forward. This one is also soft and encapsulated and about 1 1/4 inches in diameter. There is no dullness over the chest and no change in the respiratory excursion. There are diffuse squeaks and wheezes scattered all over the left chest and a few also at the right base. There are no glandular enlargements. The liver and spleen are not enlarged. The abdomen is negative.

Dr. Harold Brunn operated on the child. Dr. Kusk reported the specimen to be a lymphangioma (Fig. 13).

Recognition of cystic disease is not impossible in forms sufficiently severe to produce symptoms—in the milder ones recognition is unimportant. In the infantile form unexplained recurring severe attacks of cyanosis and dyspnea with signs simulating pneumothorax, displacement of the mediastinum, hyperresonance, and absent breath sounds, will arouse suspicions which the X-ray may confirm. A shadow across the air filled chest corresponding to an interlobar fissure will permit of differentiation of a dilated cystic lung from pneumothorax, injection of the cysts through the chest wall with lipiodol may show



Fig 14 Case 6 A large encapsulated tubercular empyema of 5 years' standing simulating a cyst



Fig 15 Case 6 Lateral view

the cystic structure still more clearly and is perfectly justifiable, for the pressure dyspnoea can only be relieved by puncture or thoracotomy

Cystic disease in the adult may remain silent as long as the cysts are sterile and filled with mucus or air (Case 1) When infection supervenes they present the picture of a widespread bronchiectasis with cough, copious purulent sputum, dyspnoea, fever, sweats, and other constitutional symptoms The chest wall of the affected side is retracted The retraction probably takes place in early childhood, in infants the affected side may be distended Accordingly as the cavities contain fluid or air, percussion may give a dull or a resonant note, in the adult the pleura is usually thick enough to mask any resonance the underlying cavities may produce Breath sounds may be absent or tubular and there may be the tinkle of a large cavity such as one is accustomed to associate with pneumothorax

Bronchoscopy may reveal anomalies of the bronchial tree

The X-ray may show a single large annular shadow if the cyst is empty, or a more or less globular area of density if it is full of fluid The density of a single cyst, especially if more or less pneumonic infiltration accompanies it, may be not round but quadrilateral or wedge shaped

Wedge shaped shadows are indistinguishable from interlobar collections of fluid, the rectangular ones may arouse suspicion that they are due to another cause When the cysts are empty, multiple cystic disease is documented by a network of honey-comb or grape-cluster like shadows occupying part or whole of a lobe (Case 4) or even a whole lung (Case 3) When they contain fluid or are infected separate cysts are usually indistinguishable in the uniform grayness of a surrounding acute or chronic pneumonic reaction If the cysts communicate with a bronchus lipiodol injection demonstrates them beautifully, large or small areas of the lung field being sprinkled with half-moon shaped fluid levels that look like the images cast on the ground by an eclipse of the sun (Case 3) Larger dependent cysts may be entirely filled (Case 2) Cysts without a bronchial opening may be outlined in negative by the iodized oil which pours into the open bronchi surrounding them but leaves the cyst itself blank These films give good stereoscopic pictures but do not adapt themselves to reproduction

Differential diagnosis The solitary congenital cysts are most frequently confounded with other cystic collections, such as echinococcus (Sauerbruch), interlobar empyema (Clairmont), or with dermoids and similar solitary tumors



Fig 16 Case 7 Incapsulated tubercular effusion simulating a cyst

A large robust iron worker who was under the care of most competent observers for 5 years (among them the late Dr A W Hewlett) offers an interesting instance of the difficulties of diagnosis. In 1922 he was at Stanford Hospital with a cystic collection of fluid (Figs 14 and 15). He had no fever, cough, nor sputum. Aspiration yielded a syrupy fluid containing staphylococci. He was discharged without a definite diagnosis having been made. In 1926 after various sessions at other hospitals he entered St. Luke's. The cyst was opened and drained of a chocolate colored content; its wall was beset by chalky coral like plaques of stony hardness. Examination of the fluid and sections of the wall by Dr Ophuls revealed layers of fibrous tissue without scolices or other characteristic constituents. After operation the man's temperature continued to rise without apparent reason, the cyst cavity being well drained and clean. Films revealed a small interlobar effusion of the sound side which was tapped of a milky serous fluid. Guinea pig injection finally established the diagnosis of tuberculosis.

Films (Fig 16) of a girl of 16 also depict a chronic encapsulated tubercular pleurisy or tubercular abscess.

The difficulties of diagnosis of a single cyst, therefore, may be great. Time, continued observation, constitutional signs of disease (urticaria, an echinococcus and echinococcus or syphilitic complement fixation reaction) pulmonary tuberculosis elsewhere, aspiration and examination of the contents of the cyst and especially the findings at

operation will usually solve the problem. Operative findings are most important, for the epithelial lining of a cyst, visible both to the naked eye and microscopically, is quite different to the fibrous lining of an empyema or other pleural cavity, and is perfectly characteristic. Suspicious also is a consistently mucoid or mucopurulent secretion. The pus from an empyema may be thick and slimy at first but as drainage continues it becomes more and more frankly purulent (unless dissolved by Dakin's solution), the pus of an infected cyst is mucoid at first and continues so as long as the cyst secretes. Minute multiple cysts are of no importance and are unrecognizable.

Multiple cysts of medium size are more easily recognized. Whether to consider them congenital or acquired, and the expression of true congenital cystic disease, or of a severe acquired bronchiectasis, is an academic question that lobectomy or autopsy even is not able to settle conclusively.

Three patients each with a whole lung converted into a series of pus containing sacs, the one apparently congenital, the second syphilitic, the third following an operation for hydrocele, presented exactly similar findings both at operation and in the X ray examination. It is impossible to say whether the syphilitic and the postoperative ones had latent cystic disease made manifest by the implantation of an infection, or whether the apparently congenital one was not like the others, acquired and the result of a sinusitis or some other hidden infectious process.

A Nova Scotian nurse of 28 years was kindly referred by Dr James R. Bullitt of San Jose. She had been prone to coughs and colds since a little girl and had had much trouble with her nose. As a child her colds used to appear only in the winter, lately fever and chills occurred every few months and lasted a week or two. Her temperature rose to 102 degrees and she was very sick. She brought up large amounts of purulent non-offensive sputum.

She had had nasal polyps and in the midst of one of her attacks a right otitis media which ruptured through the ear drum. The ear had discharged since.

Films after lipiodol injection demonstrated bilateral basal cavities. At autopsy both lower lobes were found converted into a conglomeration of grape cluster like saccular cavities. In the right middle lobe the cavities were more cylindrical (Fig 18). Microscopically the cavities were inflamed and ulcerated. There was a heavy submucous inflammatory deposit and the epithelium was largely ulcerated. The cavities all seemed to connect with the bronchial tree. There were numerous although rather small patches of anthracotic pigment.

The pigmentation, ulceration and the various forms of bronchiectatic dilation, with round cavities in the lower and cylindrical ones in the middle lobe made it likely that this patient's disease was acquired rather than congenital.

Large multiple cysts converting the whole lung and whole lobes into a unilocular or multilocular pus containing sac have been most frequently

mistaken for empyema (Sauerbruch 2 cases, Case 3) The mistake is easy, the wall of the cyst is thin, fibrous, and contains no visible pulmonary parenchyma It is impossible to distinguish it from a thickened pleura unless one inspects it at operation, when its pearly lustre, its division into multilocular cavities, and the appearance in it of bronchial openings which show either as narrow slits or fine circular openings will reveal its true character as an epithelialized cystic cavity After they have been opened for some time the cysts assume the aspect termed by Lebsche "gridiron lung", the epithelium becomes pink and velvety, the partitions stand out, the cavities retract and the bronchial openings often appear more clearly Communication with the bronchi may be more or less free, more or less air may be expelled from the wound, and more or less of the fluid contents of the cyst be expelled into the bronchi

The possibility should be borne in mind that any unusually obstinate large empyema cavity which after operation shows no tendency to contract, may be not an empyema but a congenital cystic lung

Treatment is indicated only when the cystic anomaly causes symptoms These will occasionally be due to pressure of a solitary cyst on the bronchi or on the great vessels (Rach), when an attempt at removal is in order Pressure symptoms may also arise from hyperinflation or distention of an infantile cystic lung which should be relieved after the manner of Miller by introduction of a one-way valve tube

Extirpation may offer considerable difficulty It has been remarked that solitary cysts may have a pedicle attached to the trachea or œsophagus Access may be gained via an anterior mediastinal route or through the pleura, either in two stages, after production of pleural adhesions if the cyst is infected, or directly if it is presumably sterile, or through the lung itself An infected cyst had best first be drained through a sufficiently large opening, the lung having previously been made to adhere by an extrapleural tampon, and attempt at removal be left for later, should a fistula persist

Large multilocular cysts, if infected, should be widely opened and drained, when they are clean the shell of the lobe containing them is dissected free of its surroundings until it depends from a pedicle Dissection from the chest wall and from the pericardium is fairly easy, dissection from the diaphragm and along the interlobar fissure usually difficult, the diaphragmatic and interlobar adhesions being tougher and denser than those to the chest wall and pericardium When a pedicle



Fig 17 Case 8 Probably an acquired cystic bilateral bronchiectasis of right middle and both lower lobes (the cavities have been injected with a barium gelatin mixture)

representing the connection of the cystic lobe with the bronchus and the large pulmonary vessels is reached, the vessels and bronchus are separated, the vessels accurately caught and tied, the bronchus severed and sutured with interrupted stitches of fine black silk, and the stump covered with the remnants of the cystic lobe which are held in place with fine catgut The scar of previous operation is excised from the skin and the soft parts closed except for a small drain Phrenicotomy will help obliterate the large cavity left by removal of the lobe, often enough ribs will have been removed at previous sessions to make further thoracoplasty unnecessary The remaining lobe dilates, the chest wall sinks in and the large defect closes surprisingly quickly

In Case 2, and in 2 other cases in which there was reason to suspect involvement of a whole lung, removal of the lower lobe seemed sufficient The cysts of the upper lobe drained by their own gravity and produced little or no symptoms, after removal of the infected lower lobe In one patient the sputum has dropped to 4 cubic centimeters per day, the patient is well and working In another it measures about 15 cubic centimeters, the patient is well, has gained much weight, and is no longer disabled

Whether or not one wishes to treat infected cystic lungs by thoracoplasty will depend on the taste of the operator. Certainly before doing so, one should make sure by means of the bronchoscope that communication between the cysts and the bronchi is free, to compress the infected cysts unless their secretions have a free vent toward the bronchi would be to invite disaster. Personally the results of drainage with subsequent lobectomy and closure of the bronchial fistula have been sufficiently encouraging to incline me against the uncertainty of less direct methods of attack.

SUMMARY

1 Four cases of congenital cystic lung are described

2 Solitary congenital cysts are often mistaken for interlobar empyemas

3 Encapsulated tubercular pleurisy may be difficult to distinguish from solitary cysts

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Contains both graphics

EPITHELIZATION OF BONE CAVITIES AND CALCIFICATION OF FIBROUS MARROW IN CHRONIC PYOGENIC OSTEO-MYELITIS

ALEXANDER BRUNSCHWIG, M.D., CHICAGO

From the Department of Surgery of the University of Chicago

THREE cases of chronic pyogenic osteomyelitis of over 50 years' duration, presenting large bony cavities and draining sinuses, were recently observed. Study of the specimens obtained showed partial epithelization of the bony cavities. This was the result of proliferation of the cutaneous epithelium along the sinuses. Sequestra with calcified marrow and calcification of marrow in living bone was also noted.

The epithelization of the cavities obviously was a determining factor in the clinical course of these cases, for a cavity with a narrow outlet lined by epithelium will persist and will have a continuous discharge. This condition is perhaps not uncommon in chronic osteomyelitis with cavitation but a review of the literature failed to yield reports of similar observations.

CASE REPORTS

CASE 1. B. O. H. (2504), admitted to the University of Chicago Clinics February 2, 1928. White male, aged 63 years, had suffered from chronic pyogenic osteomyelitis of the lower portion of the right femur since the age of 12. This began spontaneously with redness, pain, swelling, and fever. Following operation, a draining sinus persisted laterally above the knee. At 18, another operation was performed after which the sinus remained closed until 1912, when because of severe pain a third operation was performed for drainage (rubber tubes used), and removal of dead bone. Since this date, 16 years ago, a discharging sinus has persisted at the site of the last operation.

Physical examination revealed nothing special aside from the right thigh. It was larger than normal in the lower half and on the lower lateral surface there was a linear scar 8 centimeters long and a sinus with raised rolled edges from which profuse foul smelling pus was discharged. On the lower medial surface of the thigh were healed linear scars. There was thickening of the periarthral tissue of the right knee and some atrophy of the right leg muscles.

Roentgenograms (Fig. 1) of the right femur showed shadows of an irregularly thickened cortex and an area of irregularly reduced density along about 5 inches of the medullary canal suggesting a cavity. Near the middle of this area were two dense shadows suggesting the presence of rubber tubing. In the lower part of the cavity were dense irregular shadows free of which were sharply circumscribed suggesting free bodies, while a large irregular one had a more diffuse outline.

Operation was performed on March 12, 1928, under ethylene anesthesia. A lateral incision was made from the external condyle extending upward for 20 centimeters passing through the sinus. The lateral portion of the femur exhibiting a sinus through the cortex was exposed. On chiseling away the sclerotic cortex of the posterior

inferior half of the shaft, a cavity was opened which contained a purulent exudate, two fragments of old rubber tubing, and several irregular dark brown, brittle, porous sequestra (Fig. 2). The cavity had a thick, fibrous lining in most of its extent which was easily curetted away and several irregular dark brown, sclerotic fragments bordered on its walls and were attached to underlying bone. They were evidently in the process of sequestration. After thorough evacuation and "craterization" of the cavity, it was packed with gauze and the upper portion of the wound sutured. Convalescence was uneventful but a sinus persisted.

The patient was last seen on April 10, 1930. A large discharging sinus was present in the lower lateral portion of the thigh. There was pain in the limb necessitating 30 to 40 grains of aspirin a day for relief. A forceps was inserted deeply into the sinus and several small fleshy fragments of tissue were removed from the opposite wall and examined microscopically.

Pathological study.¹ Sections were made from three different fragments of the soft, fleshy lining of the cavity removed at operation March 12, 1928. These were composed of dense fibrous tissue in which there were diffuse leucocytic infiltration and scattered large foci of lymphocytes with true germinal centers. Along one margin of the sections were small stretches of mature, stratified, squamous epithelium exhibiting stratum germinativum and stratum malpighii but no superficial horny layer. No hair follicles or sebaceous glands were seen. One section (Fig. 3) showed a rather long stretch of epithelium continuous on each side with a layer of granulation tissue (pyogenic membrane). Thus the cavity appeared to have been lined in part by islands or sheets of stratified squamous epithelium.

Sections through sequestra (Fig. 4) showed them to be composed of dead bone, in the large marrow spaces of which were finely granular calcareous deposits much denser in some places than in others. In places, this deposit had a definite lamellar appearance (see microscopic findings in Case 3) strongly suggesting calcification of dense bundles of collagenic tissues. In other places the deposits were about islands that had been occupied by fatty marrow. Mixed with the calcareous material was considerable dark brown granular precipitate. This was also deposited on the surfaces of the bony trabeculae thus accounting for the dark color of the sequestra. It was thought that the dark color might be due to the presence of iron sulphide or hemosiderin, but when sections were immersed in acidified potassium ferrocyanide solution, the Prussian blue reaction was not obtained.

Microscopic study of the minute fragments of tissue removed from the wall of the cavity opposite the sinus in April, 1930, showed them to be composed of stratified squamous epithelium, demonstrating that extensive epithelization of the cavity had recurred in the 2 years since operation (Fig. 5).

¹In all histological studies in this report, the blocks of tissue were fixed in 10 per cent formalin solution, and if soft were embedded in paraffin. Blocks containing bone were decalcified after fixation in 5 per cent nitric acid in normal saline solution and embedded in celloidin. The stains used were Ehrlich's hematoxylin and eosin.

Whether or not one wishes to treat infected cystic lungs by thoracoplasty will depend on the taste of the operator. Certainly before doing so, one should make sure by means of the bronchoscope that communication between the cysts and the bronchi is free, to compress the infected cysts unless their secretions have a free vent toward the bronchi would be to invite disaster. Personally the results of drainage with subsequent lobectomy and closure of the bronchial fistula have been sufficiently encouraging to incline me against the uncertainty of less direct methods of attack.

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The most complete fund of information with a full bibliography is to be found in Hart and Mayer in Henke *Lubarsch Handbuch d spez Path Anat u Hist* Vol 3 14 p 469 et seq

Contains 6 pls. graphics



Fig 3 Case 1 Section showing *a-a* "island" of mature stratified squamous epithelium from lining of large cavity in femur *b* Densely infiltrated fibrous tissue Note *c-c* pyogenic membrane lining cavity in which there is no stratified squamous epithelium $\times 20$



Fig 4 Case 1 Section from one of the dark colored sequestra of dead bone found loose in the marrow cavity *a* Finely granular calcareous deposit denser in some places than in others *b* Calcareous deposit exhibiting a dense lamellated appearance *c*, Dark brown precipitated material mixed with granular calcareous deposit and lining surfaces of bony trabeculae $\times 70$



Fig 5 Case 1 Section of fragment of stratified squamous epithelium recovered from deep lining of cavity 2 years following last operation Epithelization of the cavity has thus recurred during this period $\times 70$



Fig. 6. Case 2. Cross specimen of inferior half of left femur showing *a* central cavity with large sinus through cortex in posterior position *b* sinus tract surrounded by dense fibrous tissue leading into cavity.



Fig. 7. Case 2. Photomicrograph of lining of sinus leading into bony cavity from the surface of the thigh—stratified squamous epithelial lining. Note mature and inactive appearance of the epithelial layer. $\times 55$.

resting upon infiltrated dense fibrous tissue (Fig. 7). Other sections showed that this epithelium extended into the cavity lining the inferior posterior portion and was continuous with the lining of the remainder of the cavity which was seen to consist of a typical pyogenic membrane (Fig. 8). The epithelium in the cavity differed decidedly from that lining the sinus. In the former the cells were all quite large and irregular; in places there was no definite stratum germinativum but slender processes of epithelial cells were seen to extend into the subjacent layer of fibrous tissue and for a little distance over the neighboring pyogenic membranous lining. Here the appearance of the epithelium suggested active proliferation. In the epithelium lining the sinus the cells were all smaller, there was a definite stratum germinativum and stratum malpighii and a wide keratohyaline zone. The regularity in arrangement and size of the cells in the basal layer indicated no proliferative activity. The upper portion of the cavity was lined by bone and granulation tissue.

CASE 3. H. A. W. (1674) admitted to the University of Chicago Clinics January 17, 1930. White male aged 65 years, lawyer. At the age of 32 he developed osteomyelitis of the lower half of the left femur. Following incision and drainage a discharging sinus persisted for the next 6 years. Operation was then performed for further drainage of abscess and curettage of bone. A year later two more incisions were made with removal of dead bone on each occasion. The sinus then closed and remained so for 25 years during which time the patient had occasional attacks of pain in the thigh but there was no deleterious effect on his general good health. In 1910, 32 years after the original trouble, there was a return of symptoms and a

roentgenogram showed a bone abscess in the lower portion of the left femur. This was again opened and drained with curettage of surrounding bone. Since that time the sinus has persisted and the femur has been operated upon four times. In 1915 a "bone plug" was inserted and in 1917 the lining of the cavity was cauterized. At the last operation in 1927 there was extensive removal of bony walls but a discharging sinus reformed. Since 1913 the patient has had diabetes mellitus. In the last 3 or 4 months there has been marked increase in the foul purulent discharge, loss of strength in the left leg, and inability to stand long without much pain. These complaints have very seriously interfered with the patient's ability to work.

Physical examination revealed on the lower lateral aspect of the left thigh a scar 20 centimeters long in the central depressed portion of which was a sinus 5 centimeters long, draining foul pus. The skin about the scar was hyperemic and the deeper soft tissues were edematous and tender. A probe could be readily passed through the sinus into an underlying bony cavity. Scars were also present in the lower medial aspect of the thigh and in the popliteal region. Extension at the knee joint was limited to 150 degrees and flexion to a little more than 90 degrees. There was no pain or tenderness about the knee nor fluid within the joint. The spleen, liver, and kidneys were not enlarged and there were no other physical findings relative to the disease. Urine analysis showed albumin, sugar, but no acetone bodies. Blood sugar examination showed 181.8 milligrams per 100 cubic centimeters of blood.

Roentgen ray examination showed old osteomyelitis with sclerosis and cavity formation in the distal half of the left femur. The articular space in the knee joint was greatly narrowed and showed roughening of the approximating portions of the tibia and femur, particularly over the lateral side.

Because of the foul smelling discharge, the recent flare up of the process, and the great distress caused to the patient, amputation through the middle half of the femur was performed on January 21, 1930, under ethylene anesthesia. The wound healed rapidly and the patient's general condition was satisfactory throughout convalescence. He was discharged on February 8, 1930, and three days later word



Fig 8 Case 2 Section through margin of epithelial lining in the lower portion of the cavity in the femur a, Pyogenic membrane of remaining portion of lining Note proliferative appearance of epithelium here in comparison with that in Figure 7, which lines the sinus b, Processes of epithelial cells extending into subjacent dense fibrous tissue $\times 65$

was received that he had died suddenly, from pulmonary embolism

Pathological study. The lower half of the femur, disarticulated from the tibia and freed of soft parts, exhibited a very thickened adherent periosteum over a roughened cortex. There was marginalipping about the inferior articular surfaces. The cartilage itself was markedly thinned at the points of contact with the articular surfaces of the tibia and patella (weight bearing points), and in spots appeared absent altogether. On the lateral aspect of the lower portion of the shaft there was a sinus 8 centimeters long and 1.75 centimeters wide with rolled margins communicating with the marrow cavity. When bisected, the lower portions of the shaft exhibited an elongated cylindrical cavity 9 centimeters in length and 1.5 centimeters in diameter which expanded at its lower end into an Erlenmeyer flask shaped cavity 3 centimeters in diameter at its base in the metaphysis (Fig. 9). The large sinus through the lateral portion of the shaft described above led into the upper cylindrical portion of this cavity. The cortex of the shaft about the cavity was about 1 centimeter thick and the medullary cavity was filled with new bone. In the central portion of the shaft a short distance above the cavity, there was a patch of fibrous marrow, the central portion of which was calcified. In the metaphysis below the cavity, the cancellous bone was quite porous and filled by fatty and hemopoietic marrow.

The cavity itself was filled by foul smelling purulent material, containing two irregular spiculated black, calcareous masses. When the contents were cleared away, the cavity was seen to be lined by a pearly gray, fibrous rather tough membrane, quite distinct from the bone and measuring 1 to 2 millimeters in thickness. This lining was everywhere intact except at both extremities of the cavity where it appeared to be perforated by dark brown black, brittle short calcareous spicules projecting into the lumen. These, on the other hand, were closely adherent to the underlying bone and because of the gross resemblance to the free bodies mentioned above, conveyed the impres-

sion that they were similar structures in the process of detachment from the wall of the cavity. At one point the lining was raised but not perforated by a small nodule of dark brown bone. The cartilage on the superior articular surfaces of the tibia and patella was also roughened and markedly thinned or absent in the "weight bearing areas."

Sections from the wall of the cavity taken from widely separated points and from the inner opening of the sinus, showed a stratified squamous epithelial lining of variable thickness (Fig. 10). Beneath this was a zone of dense fibrous tissue throughout which were scattered numerous small blood vessels and diffuse and focal infiltration by leucocytes, mainly polymorphonuclears and lymphocytes and at one point a focus of foreign body giant cells.

The stratified squamous epithelium here again exhibited no superficial horny layer, the most superficial cells were flattened but their nuclei stained heavily and the cell outlines were still distinct. In places however, occasional 'pearls' were present in the stratum malpighii. Some sections showed rounded, empty, vacuolated areas also in the stratum malpighii (vesicles), no pigment was definitely seen anywhere in the stratum germinativum and as in the previous cases, there were no hair follicles or sebaceous glands. Polymorphonuclear leucocytes were seen migrating into the epithelium. The lining was similar to the epithelial layer covering a healed scar on the surface of the body.

This lining of stratified squamous epithelium was discontinued in but two small areas, namely, at each extremity of the cavity where the brown black spicules protruded into the lumen. Here there was acute ulceration of the epithelium about the spicules, which themselves were composed of dead, cancellous bone, in the marrow spaces of which there was a dense calcareous deposit exhibiting in places a definite lamellated structure (Fig. 11). The spicules appeared to be undergoing sequestration from the wall of the cavity.

Sections through the free spiculated masses in the cavity showed them to be composed primarily of laminated



Fig. 9. Case 3. Gross specimen. Dissected lower half of left femur showing a large cavity in shaft and metaphysis with whitish fibrous lining (epithelium) *b* loose black spiculated bodies in cavity *c* dark spicules of bone perforating epithelial lining at points of ulceration and seemingly being detached *d* patch of fibrous marrow with calcified center *e* sinus

calcareous deposit throughout which were scattered a few small fragments of dead bone (Fig. 12). Over the external surface there was a brown discoloration which was not due, however, to hemouderin as again determined by the ammonium sulphide and Russian blue tests.

In the patch of fibrous marrow above the cavity a sharply defined area of calcification was seen (Fig. 13). This deposit had a lamellar appearance and included no cell nuclei. It was in reality calcification of part of the fibrous marrow resulting from the osteomyelitis; the granules having been precipitated on bundles of collagen—hence the lamellated structure. Bordering this calcified area and within it were bony trabeculae.

Sections through the articular surfaces of femur, tibia and patella showed marked thinning or in places complete absence of the cartilage in the weight bearing areas. At the margins the articular cartilage was normal in thickness.

To repeat, the pathological changes of unusual interest in these three cases are: first, the partial epithelialization of the osteomyelitis cavities; second, in Cases 1 and 3, sequestra composed partly of bone and partly of calcified fibrous marrow and fragments of similar nature undergoing sequestration; third, in Case 3, calcification



Fig. 10. Case 3. Section showing stratified squamous epithelial lining of lower portion of cavity *a* Large epithelial pearl. The fibrous connective tissue beneath the epithelium is densely infiltrated by leucocytes. $\times 65$

in fibrous marrow of living bone some little distance from a large osteomyelitic cavity.

Aside from its presence in neoplasms and in various tissues in obscure metabolic disturbances, pathological calcification is a manifestation of senility and also occurs at the site of old healed granulomata or in soft tissues subjected to long periods of low grade inflammation where there is frank necrosis or considerable devitalization of tissue. Calcification is furthermore encountered in old scars of inflammatory origin such as the dense hyalinized fibrous tissue that follows the resorption of abscesses. That fibrous marrow in osteomyelitis presents no exception to this rule is well illustrated in Cases 1 and 3 reported.

A search of the literature fails to reveal the report of calcification in fibrous marrow and fibrous lining of old osteomyelitic cavities. This can scarcely be due to the rarity of the condition and must be explained by the infrequency with which such cavities have been subjected to detailed study. Calcification in the marrow of tuberculous sequestra has been noted by Phemister. Extensive calcification in the dense fibrous



Fig 11 Case 3. Section showing a large fragment of dead bone (*c* in Fig 10) undergoing sequestration from *d* living bone. *e* Calcification in marrow spaces. Note lamellate structure of deposit in one area, *e'* *f* Brown pigment deposited on surface of bone giving it dark colored appearance in the gross. $\times 15$

lining of an old bone cyst has been reported by the writer and also has been observed recently in the dense fibrous lining of an old osteomyelitic cavity in an amputated extremity.

Since only calcified sequestra are available for study in Case 1, it is difficult to state just when the calcification occurred in this instance. However, in Case 3 there are calcified sequestra, dead

bone in the wall of the cavity with calcified marrow undergoing sequestration, and calcified marrow in living bone near the cavity. This would suggest that the calcification in all the sequestra may have occurred in the marrow of living bone near the cavity and that as the cavity extended



Fig 12 Case 3. Section from dark colored sequestrum (*b* in Fig 9). This is composed nearly entirely of calcified marrow. Note lamellar appearance of deposit suggesting petrified fibrous marrow. *a*—*a* small fragments of dead bone. *b* Dark brown pigment covering sequestrum. $\times 60$



Fig 13 Case 3. Microphotograph of section through portion of *d* calcified fibrous marrow (*d* in Fig 9). Note dense lamellar organization of calcareous deposit. *a* Living bone. *b* Small bundles of collagen in which calcareous deposit has taken place. *c*, Fibrous marrow. $\times 63$

to these areas, the bone about the calcified marrow became devitalized, the whole mass then undergoing sequestration.

The downgrowth of cutaneous epithelium to line chronic bronchial, biliary, and anal fistulae is not an uncommon pathological finding. That stratified squamous epithelium may also proliferate to line chronic sinuses leading into bony cavities and that it may extend farther partially or nearly completely to line these cavities is well illustrated in all three of the cases which have been reported.

In the walls of the cavities where epithelization is extensive (Cases 1 and 3), the epithelium has a somewhat mature appearance. In Case 2 in which the epithelium is limited to a small area, it appears to be proliferating in attempt to extend further over the wall of the cavity.

The epithelial lining of these cavities no doubt was a factor in the prevention of healing, analogous in a way to the failure of pilonidal or sebaceous cysts to heal when even a minute fragment of the old lining is left behind at operation. On the other hand, epithelization of the walls of large bony cavities in osteomyelitis by Thiersch grafts (Lord) and by Reverdin grafts (Reid) has been recommended as a means of treatment. In these instances, however, emphasis is placed upon a preliminary conversion of the cavity into a crater or trough by chipping away as much of the walls as possible. As already stated, a cavity with *small communication to the outside*, even though it is completely lined by stratified squamous epithelium, does not heal, for accumulation of bacteria and debris within it results in continued inflammation in the surrounding tissues.

Finally, mention may be made of the fact that epidermoid carcinoma not infrequently develops at the site of old chronic discharging sinuses in osteomyelitis. Downgrowth of stratified squamous epithelium into these sinuses in which the inflammatory process affords the stimulus to malignant degeneration of the epithelial cells may be the explanation for this.

TREATMENT

In two of the three cases cited above, the inconvenience and pain caused by the lesions over a period of so many years and the obvious hopelessness of further conservative treatment, made amputation an advisable procedure. Unfortunately, neither of these two patients survived the operation for very long. In the third case, where more conservative treatment was employed, the cavity being extensively effaced by removal of much of its walls and all sequestra, foreign bodies, and soft parts, no relief from pain or purulent discharge was obtained. The condition of the leg remained essentially the same as before operation. In fact, the cavity had become lined with epithelium at the end of 2 years and there appeared to be no reduction in its size and in the amount of discharge.

SUMMARY

A histopathological study of three cases of chronic pyogenic osteomyelitis of over 50 years' duration showed:

1. Epithelization of the draining sinuses and partial to nearly complete epithelization of the large cavities in the bone to which they led.
2. Calcification of fibrous marrow in cancellous bone bordering the cavities, with infection and necrosis and partial or complete sequestration of these bony and calcified areas.
3. Calcification in fibrous marrow away from the epithelized cavities, surrounded and traversed by living bone.

NOTE.—The author wishes to thank Dr. D. B. McMaster for help and suggestions in the pathological studies.

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SERIOUS INTRA-ABDOMINAL TRAUMA WITHOUT EXTERNAL EVIDENCE OF VIOLENCE¹

FRED R FAIRCHILD, M.D., F.A.C.S., WOODLAND, CALIFORNIA

From the Department of Surgery Woodland Clinic

THERE is a group of surgical conditions of unusual interest and importance in that they are not amenable to the ordinary routine for diagnosis, yet are of such urgency that on the early and correct determination of the character of the lesion a favorable or fatal outcome depends.

As surgeons we feel commendable pride in such ability as we may possess to make correct pre-operative diagnoses. We hesitate to do exploratory incisions and apologize when we consider the procedure necessary. And this is as it should be. To suggest then that there are a group of conditions which demand immediate operation, on the basis of our inability to say that certain lesions do not exist, rather than on our ability to say that they do exist, is radical, and calculated to bring the proponent a full measure of criticism. Nevertheless, this suggestion is made and the discussion following will be an endeavor to establish the soundness of the proposition.

Those lessons which we have learned from experience we do not forget, nor should we underesti-

mate their importance. The material on which this discussion is based is collected from the author's personal observation. Certainly it cannot vary greatly from the experience of other general surgeons, who have been in the field long enough to make deductions. The conclusions reached from individual experiences may differ greatly, and therein should lie the value of this presentation. Our own conclusions are that in border line conditions of the character which we are considering, prompt explanation is mandatory and there should be few exceptions to the rule.

We propose to consider the intra abdominal traumas of a serious nature which are caused by external violence of such character as to leave little or no external evidence of injury. Such lesions are not infrequent, they are often such as to be certainly fatal without prompt surgical intervention, and the symptoms attending them may be so confusing as to make an early diagnosis impossible. Under these circumstances the problem is difficult. We cannot make a diagnosis by

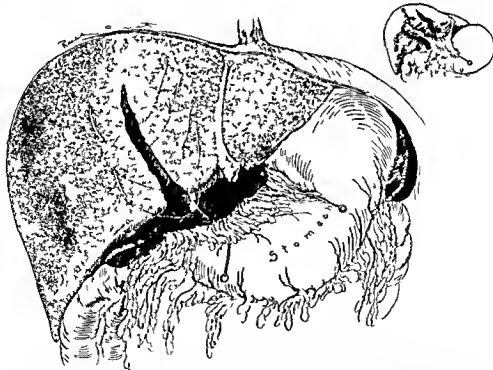


Fig 1 Woman aged 24 years. Severe crushing over upper abdomen with no external lesion, from train striking auto. Seen within 1 hour with evidence of severe shock and suspicion of intra abdominal hemorrhage. Immediate exploration with finding of ruptured liver as illustrated. Closure of fissure by mattress sutures with control of hemorrhage. Recovery.

¹Read at Pacific Coast Surgical Association, Del Monte, California, February 6-7, 1930.

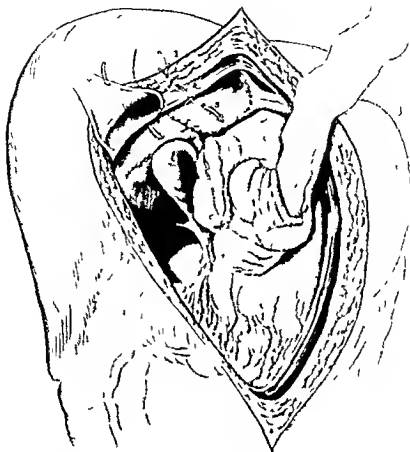


Fig. 2. Male aged 23 years. Severe crushing over upper abdomen with no external evidence of trauma. Seen 3 hours after injury in extreme shock and evidence of intra-abdominal hemorrhage. Immediate exploration. Fissure could be only partly closed by mattress sutures and packing with gauze necessary to control hemorrhage. Complete recovery after tedious convalescence.

conservative methods. If we explore we may find that the condition is non surgical. If we do not explore we may deprive the patient of his chance to live. On what, then, shall we base our decision for action? It would seem that it should be determined by the selection of that procedure which, if we are in error, will be attended by the least serious consequences. An error on the side of conservation, when surgery is required may cost a life. The logic of the situation would seem to compel a decision for the radical procedure when serious doubt exists.

Before taking specific instances illustrative of the problems, it will be helpful to review the intra-abdominal factors, both anatomical and mechanical, which are pertinent to the discussion.

The organs of the abdomen liable to trauma from indirect violence may be roughly placed in two groups: namely, those which are solid and relatively fixed in position, and those which are hollow and less positively placed. These characteristics—consistency and mobility—are factors that must be borne in mind if we are to hope for correct deductions as to the exact nature of lesions, the known factors being only the nature of the violence and the subsequent physical signs.

The solid organs that interest us in this discussion are the liver, spleen, pancreas, and diaphragm. The hollow organs entering into the picture are the stomach, small and large bowel, the urinary bladder, and the blood vessels. The author has seen fatal, or potentially fatal, lesions

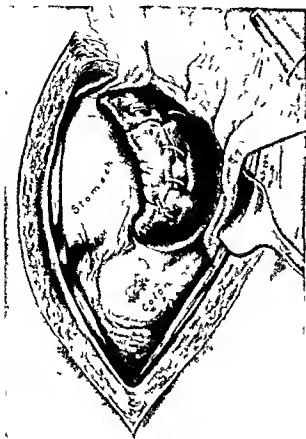


Fig 3 Woman aged 45 years. Auto accident causing severe crushing over upper abdomen. Seen 4 hours later with evidence of extreme shock and intra abdominal hemorrhage. Immediate exploration. Multiple ruptures of spleen. Mattress sutures as illustrated controlled hemorrhage. Convalescence perfect until fourteenth day when sudden death after patient was dressed for dismissal. No autopsy. Presumably death from embolus. Query. Would splenectomy have been a safer procedure?

of each of these structures one or more times from transmitted violence of such character as to leave practically no external evidence of injury. This experience convinces him that preventable deaths (preventable assuming prompt surgical intervention) are sufficiently numerous to warrant serious attention to the subject. And further, the experience teaches that prompt intervention is *not* the rule and that the percentage of fatalities is distressingly high. The liver and spleen are organs with very similar gross characteristics. Both are held in a relatively fixed relation to surrounding structures. Each is enclosed by a delicate capsule—so delicate that it is easily torn by any sudden increase in intracapsular tension. The parenchyma with each is soft and friable, not permitting any great alteration in contour without a severance in one or more places in its continuity. By reason of their glandular functions they are

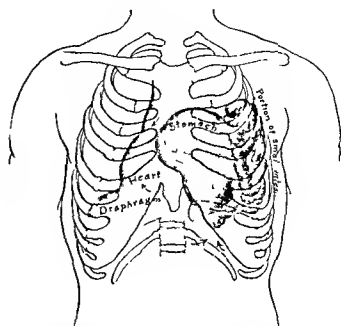


Fig 4 Male aged 42 years. Thorax and upper abdomen crushed in auto accident. Seen 2 hours after injury in great shock with fractured ribs and obvious pneumothorax and hemothorax right. Condition too critical to permit gastro intestinal series. Dismissed after 5 weeks, improving. Returned 3 weeks later with severe indigestion and cardiac attacks. Investigation demonstrated diaphragmatic hernia, left as illustrated. Operation pending. (Drawing from radiograph taken 15 minutes after barium meal.)

exceedingly vascular. Finally each organ at its upper pole has the indifferent protection of the lower part of the thoracic cage, while at the lower pole there is no protection except by soft tissues, a guarantee altogether inadequate against such violence.

Under these conditions we would anticipate rupture of the organs from crushing injuries which might not be sufficient to leave local external signs, particularly from blunt violence applied over their lower poles from below upward. It is less remarkable that such accidents do occur than that they are known to occur so infrequently. Experience compels the conviction that the incidence of these accidents is greater than is generally supposed, and that many fatalities occur from them, the nature of which is often not determined and less frequently reported.

Figures 1, 2, and 3 illustrate the conditions found with rupture of the liver and spleen. A brief case history is appended with each.

The pancreas is so situated as to be well protected, yet rupture of this organ is probably less rare than is generally supposed. Within the last month we have had as a patient a woman of 39 years who was brought to us in great shock following an automobile accident. Her extreme

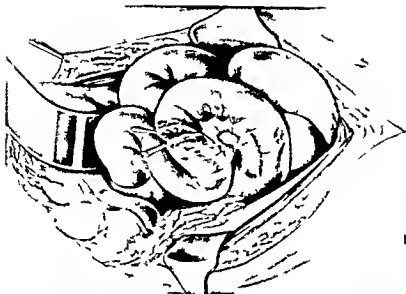


Fig. 6 Male aged 35 years Motorcycle accident Struck over upper abdomen no evidence of external trauma Seen within 1 hour Patient in shock with evidence of intra abdominal bleeding Immediate exploration was urged Advice was refused Three days later operation was permitted but the patient was *in extremis* At operation the jejunum was found completely severed a few inches from its origin as illustrated Death occurred from general peritonitis



Fig. 5 Male aged 65 years In auto wreck in Texas Struck over upper right abdomen by steering wheel Severe pain but proceeded to California by train On the seventh day sudden onset of abdominal pain in all respects similar to syndrome following perforated duodenal ulcer Seen by us 24 hours later Immediate exploration advised Laceration opening second portion of duodenum demonstrated with general peritonitis Death from general peritonitis



Fig. 7 Male aged 30 years Knocking fruit from tree with long pole which slipped and struck him over lower abdomen. Immediate severe pain but no objective sign of injury. Held under observation by his physician for 2 days, then sent to the clinic. Diagnosis of ruptured bowel with peritonitis. Immediate operation. Perforated ileum as illustrated with general peritonitis. Death from general peritonitis.

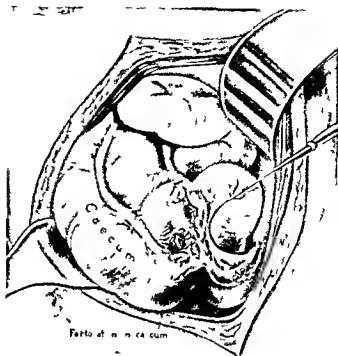


Fig. 8 Male aged 9 years Thrown from motorcycle striking lower abdomen against a post. No external evidence of injury. Treated by his family physician for 3 days then brought to the clinic. Diagnosis of ruptured bowel with peritonitis. Immediate operation. Cecum found ruptured as illustrated. Death from general peritonitis.

condition seemed to preclude the possibility of her surviving exploration. Transfusions improved her condition but slightly. She died on the third day and postmortem examination disclosed no serious lesion except a lacerated pancreas with characteristic fat necrosis. Query: Would drainage have altered the outcome?

The diaphragm is potentially subject to rupture, hernial in character, exactly as is the wall of the lower abdomen at the exits of the spermatic cords. That spontaneous ruptures occur so infrequently is due to the superior position of the organ freeing it from the direct strain of gravity. But, having the potentialities for herniation, it is not remarkable that when the one normally absent factor, namely pressure from below upward is supplied as with compression injuries the accident not infrequently occurs. Such lesions are serious and personal experience teaches that they may be easily overlooked if one is off guard for the possibility of their occurrence. The X-ray with opaque meal establishes the diagnosis. Unfortunately, as in 2 cases coming under our observation, the patient's condition was such as to make this procedure inadvisable with the result that in both instances the diagnosis was made on readmittance

some weeks later. Figure 4 illustrates the condition then found and a brief case history appended. The second case was in nearly all respects similar.

The hollow organs—the stomach, small and large bowels, the urinary bladder, and the blood vessels—have less in common than the organs of the solid group and cannot be discussed except individually.

The stomach like the organs already considered has a fair protection from the lower part of the thoracic cage. It has a considerable latitude in mobility, is strong walled and has a large lumen, all factors operating to keep it intact even in the presence of extreme violence. The author has never been privileged to see a ruptured stomach except in trauma so severe as to terminate life from causes not directly related to the stomach lesion.

The small bowel is so situated as to invite rupture from accidents such as we are considering. It has practically none of the protective factors possessed by the stomach. Portions of it are always between the anterior abdominal wall, which gives no protection against any considerable force applied from the front, and the spine posteriorly, which is a hard irregular body with fixed posterior

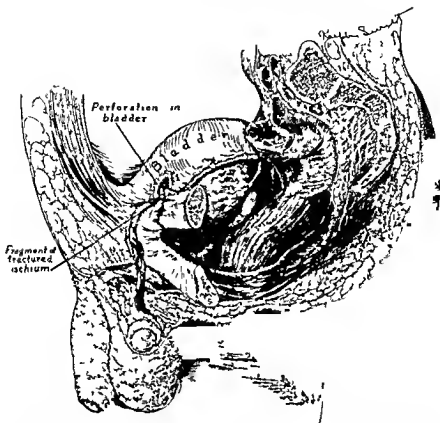


Fig 9 Male aged 21 years Pelvis fractured by overturned automobile. In a few hours small quantities of blood stained urine with edema of scrotum and evidence of extravasation of urine into soft tissues led to diagnosis of rupture of the urinary bladder. Operation demonstrated puncture of bladder from spicule from fracture of the pubic bone. Closure of bladder defect. Recovery.

limits. The small intestine is a relatively delicate structure, so delicate that a force applied to the abdominal wall insufficient to mar it would yet be great enough to press the interposed small bowel against the spine with sufficient force partially or completely to sever its continuity. This accident we have seen twelve times, with death always from peritonitis where there was minimal delay from any cause. The difficulty in obtaining the consent of the patient and the family for immediate exploration is often insurmountable. The absence of objective evidence of serious injury is an argument to them so strong for conservatism that the advice by the surgeon for operation is overruled until too late, the objective signs of peritonitis convinces them of their error (see Figures 5, 6, and 7 with appended short case histories, to illustrate the conditions).

In two instances from violence of the nature stated the actual perforation of the bowel was delayed for several days, the patient seeming in

the interval to have been not seriously injured. The symptoms of delayed perforation with its classical signs led to immediate operation. The findings compelled the conclusions that the trauma had devitalized a spot in the intestine, perforation occurring only after gangrene of the area had resulted in its dissolution.

Perforations of the small bowel are in our experience found usually in the upper one third and in observation in accord with that which would be expected from a consideration of the fact that the upper abdomen has no firm protection either anteriorly or laterally while the vertebrae in this location are most prominent. The lower abdomen is protected by the pelvis from both directions to a material degree, and the vertebrae are relatively less prominent.

The wisdom of careful observation extending over a period of some days of those patients who have suffered these accidents is suggested as necessary, this because the accident of lat-



Fig 10

Fig 10. Male aged 31 years. Was directing a Fresno scraper holding the handles. The machine struck a stump jerking him violently. He felt immediate severe abdominal pain. No foreign body came in contact with his body. Pain continued and on the second day he was brought to the clinic. His temperature was normal and he seemed to be in mild shock with general abdominal tenderness and moderate abdominal distention. Exploration was not advised we being deceived by the character of the injury. On the fourth day he became suddenly worse with positive signs of acute peritonitis. Exploration revealed a circular clean cut perforation of the jejunum 1 centimeter in diameter 7 inches from the upper extremity of the jejunum. It is believed that the trauma caused an embolus in a small end artery with local gangrene and ultimate perforation. Death from general peritonitis. Prompt exploration would probably have saved his life.

Fig 11. Male aged 50 years. Swabbing throat when he inadvertently swallowed wooden applicator 7 inches long. Three weeks later severe abdominal pain and symptoms of localized peritonitis. Exploration demonstrated the applicator had perforated the jejunum a few inches below its origin. The foreign body was removed and the wound closed. Recovery.

Fig 12. Male aged 28 years. Had appendectomy 6 years previous to entry at which time he came to the clinic with acute obstruction at about the center of the small bowel. X-ray examination revealed presence of large Hagendorn needle in the abdomen. At operation the needle was found penetrating the small bowel and surrounded by a dense mass of adhesions. Resection of 4 inches of the bowel with uneventful recovery.

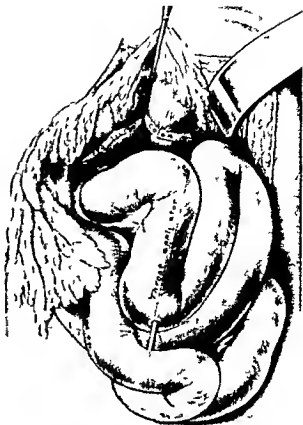


Fig 11

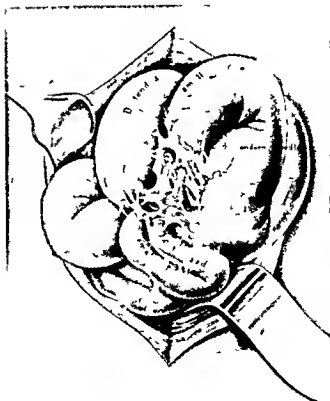


Fig 12

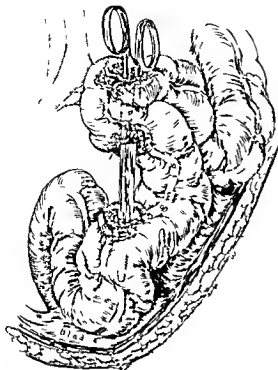


FIG. 13. Female aged 46 years. Ten years previously had had a hysterectomy followed by a stormy convalescence and continued intermittent abdominal pain. In the interval had seen several physicians and came to us with diagnosis of cancer of the large bowel. X-ray examination demonstrated 8 inch Koehler forceps in the abdomen. At operation instrument found entering and leaving sigmoid with the end again entering bowel at lower level. Resection of bowel with recovery.



FIG. 14. Female. At the age of 4 patient was kicked over the lower abdomen by playmate. Great pain and evidence of peritonitis—stormy convalescence—then continued extreme constipation emaciation and weakness. At age of 9 years was brought to clinic for diagnosis. A long hard cylindrical tortuous mass could be palpated freely movable in the central abdomen. Faecalith suspected. Operation. Faecalith in ileum 14 inches long distending bowel—spontaneous entero-enterostomy with stoma 2 centimeter in diameter and occurred immediately above the faecalith which was of stony hardness. Resection of bowel with recovery.

perforation is, from our experience, not a remote probability and the surgeon should be on guard to meet the complication.

The large bowel is fortunately much less liable to serious injury from trauma than is the small intestine, though a rupture of the colon is a matter of much greater seriousness by reason of the increased danger of peritonitis. Fortunately, the colon is so placed as to suffer little likelihood of rupture from compression against the vertebrae except where its transverse portion crosses in front of the spine and this portion, again fortunately, is the most movable segment of the large gut permitting it usually to evade destruction from pressure. We have seen but one patient with a traumatic perforation of this organ, the lesion occurring from the effect of a blow, suffered during a motorcycle accident, over the right lower abdominal quadrant (Fig. 8).

The urinary bladder is well protected against external violence by the pelvis except when force is applied during a time of extreme distention of

the viscus. Reports are numerous of rupture under these conditions, though such an accident happens not to have come within our personal observation. We have seen rupture of the bladder on two occasions in association with a fractured pelvis, an incidence great enough to permit our stressing the necessity of having in mind the possibility of this complication being present with every fractured pubic or ischial bone (Fig. 9).

The intra-abdominal blood vessels are organs subject to rupture (independent of the lesions already described) from violence more diversified in character than are any of the structures above considered. The fixed relation of certain vessels to the spine subjects them to compression rupture with immediately serious consequences. The possibility of embolism from trauma in a small or large end artery with remote complications from gangrene complicates the picture. The case (Fig. 10) reported would seem to indicate the possibility of this accident occurring from severe stress without the application of any crushing force. So

frequently does intra-abdominal hæmorrhage progress to a rapid or slow termination in death, and so impossible is it to determine symptomatically the source of seriousness of the hæmorrhage that it would seem not only justifiable but mandatory to explore every abdomen in which there is a reasonable suspicion of intra abdominal bleeding or embolus

There is another type of intra abdominal accident, without external signs of injury, that should not be forgotten. These accidents are mentioned in passing, the intent being to stress the necessity of viewing the picture in proper perspective. We must always have in mind the fact that misadventures of the past may be the key to unlock the problem of the present

We have seen numerous perforations of the alimentary canal from foreign bodies accidentally swallowed long before (Fig 11), and perforations from without the alimentary canal inward by surgical instruments, relics of past operations, the foreign bodies having been inadvertently left within the patient's abdominal cavity (Figs 12 and 13)

Obstructions may occur years after as a result of trauma of the character which we are considering. Without having in mind the possibility of these complications and without having the history of the remote injury before us, a diagnosis would not be possible (Fig 14)

At this time it would seem proper to consider in detail the problem of diagnosis and treatment, but this would not be profitable. The author fully appreciates his inability to make differentiations with any higher percentage of success than his confuses and purposes only to provoke a discussion with the idea of determining whether, in border-line cases it is considered that we are justified in pursuing expectant treatment or whether it is agreed that the path of greatest security for the greater number lies along the line of immediate exploration

SUMMARY

1 Certain forms of external violence result in fatal or potentially fatal intra abdominal lesions without leaving external signs of injury

2 In these conditions an early or accurate diagnosis is not possible. If doubt exists as to the presence or absence of serious lesions the path of greatest safety lies along the line of immediate exploration

3 Lesions of the solid organs, spleen, liver, pancreas, and diaphragm are discussed

4 Injuries to the hollow organs, stomach, small and large bowels, urinary bladder, and the blood vessels are discussed

5 Lesions from past misadventures not violent in character may result in long delayed and serious complications

THE RADICAL CURE OF HALLUX VAGUS (BUNION)

SUBARTICULAR RESECTION OF THE HEAD OF THE METATARSAL BONE

A. I. SORFESI, M.D., NEW YORK

Visiting Surgeon, Greenpoint Hospital; Consulting Surgeon, Du Sack Hospital

IN hallux vagus we have an inward deviation of the big toe. Part of the articular surface of the head of the metatarsal bone has lost contact with the corresponding articular surface of the phalanx because the head itself is pushed outward and is generally enlarged. The bursa, between the skin and bone becomes enlarged and inflamed, and it may rupture and become infected.

The best known procedures for the correction of these conditions are those of Barker, Riedel, and Mayo. We believe, however, that the technique to be described, although perhaps slightly more difficult to do than some of the others, has evident advantages, because it preserves the articular surface of the metatarsal bone, at the same time that it corrects the deformity. Thus we obtain an articulation anatomically normal and functionally very satisfactory.

TECHNIQUE

A description of the technique follows. The head of the metatarsal bone is exposed and the periosteum from the middle of the metatarsal bone to about $\frac{1}{4}$ of an inch of the articular surface is incised (Fig. 3). With a sharp thin periosteum elevator the periosteum is separated around the bone (Fig. 4). The articular surface is then de-

tached from the bone (Fig. 5). This can be done very easily and without damage if some bone is left attached to the articular surface itself, the spongy bone offers little resistance to a sharp instrument. The head of the metatarsal bone is then cut away, sufficient bone being removed to straighten the big toe. The excess of skin is removed with the bursa, and the wound is closed. A splinter is applied and the wound is dressed with gauze impregnated with glycerine or alcohol. The toe is kept at rest until any inflammation has subsided. Then passive and active movements are started.

By this technique, as shown in Figures 6 and 7, the periosteum and articular surface have been separated from about half of the metatarsal bone. When the head is resected, the articular capsule with its synovium and the periosteum falls back and covers the rough surface of the resected bone, to which it will, in a short time, adhere. Thus the head of the metatarsal bone has been removed and the articular surface has been preserved. In fact, the relations between the phalanx and the metatarsal bone have been reconstructed in a manner that is anatomically normal. The only difference between the normal phalangometatarsal bones and its articulation and the reconstructed pha-



Fig. 1. Left. Roentgenogram of foot before operation.

Fig. 2. Roentgenogram of same foot about 3 months after operation. Note bone formation under articular surface of metatarsal bone and normal appearance of articular interspace.

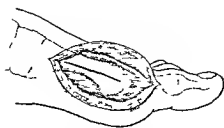


Fig 3

Fig 3 Bone and joint exposed Line of incision of perosteum

Fig 4 Periosteum elevator freeing periosteum around shaft of bone

Fig 5 Periosteum elevator freeing articular surface from head of metatarsal bone

Fig 6 Schematic drawing showing periosteum and articular surface detached from bone, along black line Dotted line showing, roughly, portion of bone to be resected

Fig 7 Schematic drawing showing periosteum and articular surface falling back on metatarsal bone after its head has been removed

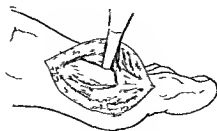


Fig 4

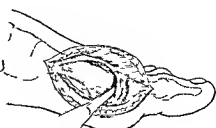


Fig 5

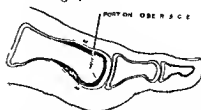


Fig 6



Fig 7

phalangometatarsal bones and its articulation is that in the latter the metatarsal bone is shorter

We wish to remark that in two of our cases, the bursa had been incised several times following successive infections. We could not obviously employ the excellent Mayo procedure, so we attempted the operation described, and obtained the satisfactory results shown in Figures 1 and 2. Since then we have adopted the same technique in all our cases and the results have been most gratifying.

That the operation is anatomically and physiologically correct seems to us evident. That the results are functionally satisfactory is demon-

strated clearly, especially by the case, the roentgenograms of which are reproduced in Figures 1 and 2. The patient was a professional dancer, and she was able to resume her dancing in less than 3 months after operation, notwithstanding the fact that the bursa had previously been repeatedly incised and infected before the radical operation was performed.

CONCLUSIONS

We feel justified in presenting to the profession a procedure in which hallux vagus may be radically cured, even when the bursa has been infected, by resecting the head of the metatarsal bone and preserving the articular surface, thus reconstructing a normal phalangometatarsal articulation.

ACUTE PERFORATED ULCERS OF THE STOMACH AND DUODENUM

REPORT OF ONE HUNDRED FIVE CASES¹

J. WILLIAM HINTON, M.D., F.A.C.S., NEW YORK

Assistant Professor of Surgery, New York Post-Graduate Medical School and Hospital; Assistant Attending Surgeon, Bellevue Hospital; Assistant Attending Surgeon, St. Mark's Hospital

DURING the past 19 years, or from 1911 to 1929 inclusive, there have occurred on the Fourth Surgical Division at Bellevue Hospital 105 cases of acute perforated ulcers. Since starting the Gastro-Enterological Clinic of the Fourth Medical and Surgical Divisions in January, 1928, we have made every effort to get each of these cases back for observation. In analyzing the cases we have divided them according to year of occurrence to find out whether there is an increase in the frequency of perforated ulcers, and from Table I a definite increase since 1923 is shown. One frequently hears the statement made that the symptoms of chronic ulcers bear a definite seasonal relationship, recurring usually in the spring and fall of the year. From Table II one is impressed by the fact that in the spring and fall the frequency of perforations is much more common. One fourth of the perforations occurred during the months of April and November. The histories have been studied carefully to determine what percentage of patients had histories of previous gastric disturbance, and also what number give no evidence of gastric complaint until the time of perforation. It is often stated that 70 to 80 per cent of perforated ulcers occur in patients without a previous gastric history. In reviewing Table III it will be seen that our statistics do not bear out this assertion. Any case with symptoms of 10 days or less has been considered a negative gastric history. In our group of cases there have been only 2 acute perforated ulcers in females, while there have been 103 in males.

The cases have been divided into 3 groups: (1) deaths, (2) cases not followed, (3) cases under observation.

Group 1 is again divided into A, cases not operated upon, and B, those who were operated upon.

Group 1A. There were 5 cases in which death was due to a perforated ulcer although in 3 of these cases a clinical diagnosis was not made. See Table IV. Needless to say, if the patients had given sufficient symptoms to warrant a diagnosis of acute surgical abdomen, an exploratory laparotomy would have been performed. This group included 1 female and 4 males. The ages varied from 37 to 80 years, the average age

being 53 years. Of the 2 cases in which the diagnosis was made, one was moribund on admission and an operation was not deemed advisable, while the other case refused operation and died 3 days later. Of the 3 undiagnosed cases, 2 had double ulcers. One case, female, age 80 years, had an ulcer on the lesser curvature near the cardiac end of the stomach, and another in the duodenum which had perforated and which was the cause of death. The other case, a male, aged 53 years, had a duodenal ulcer which had perforated and there was also a gastric ulcer on the lesser curvature. In spite of the fact that 2 of 3 of these cases had double ulcers there were not enough symptoms referable to the gastro-intestinal tract to suspect a perforated ulcer.

Group 1B. There were 20 cases that died following operation for acute perforation. They varied in age from 27 to 70 years, the average age being 47 years. Table V gives the type of operation, location of lesion, time that elapsed before operation, and cause of death. It is frequently stated that gastric or corporeal ulcers do not perforate, but one case, a male, aged 55 years, was explored for a perforated ulcer which was not found, while at necropsy there was found about 1½ inches from the cardiac opening of the stomach an ulcer which had perforated into the left pleural cavity, there being considerable stomach contents in the pleural cavity. Another case followed in the Gastro-Enterological Clinic was one with a definite gastric ulcer and positive X-ray findings. The patient became symptom free and X-ray examination was negative under medical management and remained so for 7 months, but his symptoms returned when the X-ray films showed positive evidence of a gastric ulcer, so he was admitted to the Medical Wards for treatment. After remaining in the hospital for 10 days he left. The ulcers perforated 5 days later, and at operation there was found on the posterior wall of the stomach a perforation which extended into the lesser peritoneal sac.

Group 2. This group is again divided into A, cases not operated upon, and B, those who were operated upon.

Group 2A. There were 2 cases with a typical history of perforated ulcer, with physical findings

¹Read before the American Gastro-Enterological Association, May 5, 1930, Atlantic City, New Jersey.

TABLE I—YEAR OF PERFORATION

| Year | Died | Improved | Total |
|------|------|----------|-------|
| 1911 | 0 | 1 | 1 |
| 1912 | 2 | 0 | 2 |
| 1913 | 1 | 2 | 3 |
| 1914 | 1 | 3 | 4 |
| 1915 | 2 | 1 | 3 |
| 1916 | 0 | 2 | 2 |
| 1917 | 3 | 3 | 6 |
| 1918 | 1 | 4 | 5 |
| 1919 | 1 | 3 | 4 |
| 1920 | 0 | 3 | 3 |
| 1921 | 1 | 2 | 3 |
| 1922 | 1 | 4 | 5 |
| 1923 | 3 | 6 | 9 |
| 1924 | 2 | 6 | 8 |
| 1925 | 1 | 7 | 8 |
| 1926 | 3 | 5 | 8 |
| 1927 | 1 | 8 | 9 |
| 1928 | 1 | 8 | 9 |
| 1929 | 1 | 12 | 13 |
| | 25 | 80 | 105 |

TABLE II—MONTH OF PERFORATION

| | Cases |
|-----------|-------|
| January | 6 |
| February | 9 |
| March | 10 |
| April | 13 |
| May | 9 |
| June | 5 |
| July | 7 |
| August | 6 |
| September | 8 |
| October | 11 |
| November | 13 |
| December | 8 |
| | 105 |

TABLE III—ANALYSIS OF CASES FOR GASTRIC COMPLAINTS

| | Cases |
|------------------------------------------|-------|
| Previous history of gastric symptoms | 62 |
| No mention made of past gastric symptoms | 24 |
| History negative for gastric disturbance | 19 |

confirming the diagnosis, but both patients refused to be operated upon and each left the hospital at his own request. The outcome of these cases is not known.

Group 2B. Thirty-six cases have been operated upon which we have been unable to follow. These cases varied in age from 17 to 59 years, the average age being 35 years. There was one female in this group. Table VI gives the type of operation and location of lesion. There is very little that can be gained from the study of this group, with the exception of one patient, a male, aged 43 years, who at operation had a rupture of 2 pyloric ulcers, both of which were closed by simple suture, plus a gastro-enterostomy. There

TABLE IV—DEATHS OCCURRING IN PATIENTS NOT OPERATED UPON

| | Cases |
|----------------------------------------------------------------------------------------------------------------------------|-------|
| Diagnosis not made | 3 |
| (Two had double ulcers but the duodenal ulcer perforated in each instance. Symptoms did not lead one to suspect an ulcer.) | |
| Diagnosis made | 2 |
| (One case moribund on admission and the other one refused operation.) | |
| Location of lesion | |
| Duodenum | 3 |
| Duodenum and lesser curvature | 2 |
| Cause of death | |
| General peritonitis in all | 5 |

TABLE V—DEATHS AFTER OPERATION

| | Cases |
|----------------------------------------------|-------|
| Type of operation | |
| Simple closures | 15 |
| Horsley pyloroplasties | 2 |
| Closure plus gastro-enterostomy | 1 |
| Simple excision of ulcer | 1 |
| Exploratory laparotomy without finding ulcer | 1 |
| Location of lesion | |
| Duodenum | 18 |
| Stomach | 2 |
| Hours elapsing before operation | |
| Six | 2 |
| Twelve | 3 |
| Twenty four | 11 |
| Forty eight | 1 |
| Seventy two | 2 |
| Ninety six | 1 |
| Cause of death | |
| General peritonitis | 14 |
| Pneumonia | 4 |
| Peritonitis and diabetes | 1 |
| Pyothorax | 1 |

TABLE VI—PATIENTS OPERATED UPON BUT NOT FOLLOWED

| | Cases |
|---------------------------------|-------|
| Type of operation | |
| Simple closure | 23 |
| Closure plus gastro-enterostomy | 12 |
| Horsley pyloroplasty | 1 |
| Location of lesion | |
| Duodenum | 27 |
| Pylorus | 6 |
| Stomach | 3 |

was also another case, a male, aged 31 years, with a history of an ulcer for 3 years that perforated on May 29, 1923, and a pyloric ulcer was found at operation. A simple closure was done. Patient was symptom free until November 15, 1925, when he again suffered a perforation and a pyloric ulcer was again found. A simple closure was done. He was symptom free following this but had a gastro-enterostomy done June 1, 1926, since which time he has not been seen.

Group 3. There are now under observation in the Gastro-Enterological Clinic 42 patients who

TABLE VII—PATIENTS UNDER OBSERVATION SINCE OPERATION

| No. | Date | History of gastric distress | Location of lesion | Type of operation | Course since operation | Last seen | X-ray | Follow up | Condition |
|-----|----------|-----------------------------|--------------------|---------------------------------|----------------------------------------------------------------------------|-----------|------------------------------------------|--------------------------------------------------------------------------------|--------------------|
| 15 | 2-14-14 | 1 week | Pyloric | Simple closure | Symptom free until 1-15-19 | 2-26-20 | Refused | Social service visit 9-16-20 moved address unknown | Satisfactory |
| 24 | 10-16-19 | 1 week | Duodenal | Simple closure | Symptom free until 10-30-23 | 1-9-20 | Duodenal ulcer 1-23-20 | Social service visit 11-11-20 none home note left 1-7-20 moved address unknown | Satisfactory |
| 33 | 11-13-20 | 4 years | Duodenal | Closure and gastro-enterotomy | Well for 3-4 years, now pain 3-4 hours after meals | 6-15-20 | Negative 6-10-20 | Does not reply and to letters of state | Fair |
| 40 | 9-17-20 | Several years | Gastric | Closure and gastro-enterotomy | Abdominal pain and constipation | 3-8-20 | Duodenal ulcer enteritis, no mal 7-14-20 | Returns regularly | Satisfactory |
| 50 | 7-13-21 | Few weeks | Duodenal | Simple closure | Slight discomfort | 2-15-20 | Duodenal ulcer 11-9-20 | Returns regularly | Satisfactory |
| 55 | 5-11-21 | None | Duodenal | Closure and gastro-enterotomy | No complaints | 2-25-20 | Negative 7-21-20 | Returns regularly | Satisfactory |
| 70 | 1-11-24 | 7 months | Duodenal | Horsley pyloroplasty | Abdominal pain | 2-23-20 | Duodenal ulcer 1-31-20 | Returns regularly | Satisfactory |
| 80 | 10-5-24 | 7 to 8 years | Duodenal | Horsley pyloroplasty | No complaints, exercise, diet, etc. 1-10-25, no return normal at that time | 4-25-25 | Negative 10-10-21 | Social service visit 10-15-20 moved no address | Satisfactory |
| 90 | 11-17-24 | Few weeks | Duodenal | Simple closure and antrumectomy | Well for 3 1/2 years | 2-23-20 | Duodenal ulcer 10-21-23 | Social service visit 9-10-20 Died from pneumococcus meningitis 3-27-20 | Fair until he died |
| 100 | 12-23-24 | 4 years | Duodenal | Horsley pyloroplasty | Has had abdominal discomfort | 8-25-25 | Duodenal deformity 8-4-25 | Social service visit 22-16-20 moved no address | Fair |
| 110 | 2-17-25 | 3 weeks | Pyloric | Simple closure | No complaints | 1-5-20 | Duodenal deformity 5-25-25 | Social service visit 12-16-20, neighbor reports patient well | Satisfactory |
| 120 | 5-13-25 | 3 years | Duodenal | Horsley pyloroplasty | Has had recurrent attacks of pain, but no return normal after 3 months | 10-10-20 | Duodenal irregularity 11-19 | Returns at irregular intervals | Fair |
| 130 | 6-16-26 | None | Duodenal | Simple closure | Free from complaints | 22-23-20 | Duodenal ulcer 22-16-19 | Returns irregularly | Satisfactory |
| 140 | 2-15-27 | 10 years | Duodenal | Closure and gastro-enterotomy | Has had pain and vomiting | 7-25-25 | Refused | Social service 1-20-20 no address | Fair |
| 150 | 1-16-27 | None | Gastric | Excision of ulcer and closure | Had discomfort which came on a few months following operation | 3-31-20 | Duodenal ulcer 1-23-20 | Social service visit 11-16-20 moved no address | Fair |
| 160 | 4-14-27 | Few weeks | Pyloric | Simple closure | No complaints | 10-30 | Negative 1-4-20 | Returns regularly | Satisfactory |

TABLE VII.—PATIENTS UNDER OBSERVATION SINCE OPERATION—Continued

| No | Date | History of ulcer | Location of lesion | Type of operation | Course since operation | Last seen | X ray | Follow up | Condition |
|----------|----------|------------------|----------------------------|----------------------------------|-----------------------------------------------------------------|-----------|---------------------------------------------|---------------------------------------------------------------------------------------------------------------------------|--------------|
| 17 30 | 10 18 17 | None | Duodenal | Simple closure | Symptom free for 18 months | 3 22 30 | Negative 1 20-28 20 1 25 10 1 29 1 31 30 | Returns regularly | Satisfactory |
| 18 17 | 2 14 28 | None | Duodenal | Simple closure | No com. pints | 22 1 28 | Negative 11 19 28 | 6 8 29 letter from mother no com. pints Social service visit 10-7 29 no com at home left note Also 2 15 30 no one at home | Satisfactory |
| 19 45 | 3 6 20 | 1 year | Duodenal | Horsley pyloroplasty | Slight discomfort at times | 3 22 30 | Pyloric deformity 3 5-30 | Returns regularly | Satisfactory |
| 20 35 | 4 20-23 | 1 month | Duodenal | Simple closure | No complaints | 12 28 28 | Refused | Social service visit 11-6 29 moved no address | Satisfactory |
| 21 41 | 4 11 28 | 1 week | Duodenal | Simple closure | No complaints | 12 15 28 | Refused | Left out of town does not respond to letters | Satisfactory |
| 22 49 | 3-6-28 | 2 weeks | Duodenal | Simple closure | Well except for rheuma- tism | 3 22 30 | Negative 3 1 30 | Returns irregularly | Satisfactory |
| 23 28 | 8 20-28 | 3 months | Duodenal | Simple closure | Has had abdominal pain | 5 25 29 | Duodenal ulcer 1 24 29 | Social service visit 10-7 29 moved no address | Fair |
| 24 30 | 9 7 28 | 1 year | Pyloric | Simple closure | Has had abdominal pain which began a few months after operation | 3 22 30 | Duodenal deformity 3 20-30 | Returns regularly | Fair |
| 25 31 | 10-1 28 | Months | Duodenal | Simple closure | Slight discomfort | 22 10 28 | None | Social service visit 2 15 30 moved address unknown | Satisfactory |
| 26 22 | 4 30-19 | None | Duodenal | Closure and gastro-enter- ostomy | Symptom free when last seen | 7 23 29 | None | Social service visit 12-9 29 Not known | Satisfactory |
| 27 22 | 4 30-19 | None | Duodenal | Closure and gastro-enter- ostomy | No complaints | 1 3 29 | None | Social service visit 3 to 30 Daughter says he is 33 pyloric free sure opera- tion | Satisfactory |
| 28 52 | 5 5 20 | 4 weeks | Gastric two per- forations | Simple closure | No complaints | 8 17 29 | None | 2 10-30 working no complaints | Satisfactory |
| 29 33 | 7 8 29 | None | Duodenal | Simple closure | No complaints | 9 28 9 | None | Social service visit 9 22 29 No one at home left note | Satisfactory |
| 30 24 | 7 18 29 | None | Duodenal | Simple closure | No complaints | 9 19 29 | None | Social service visit 3 2 30 no one at home Note left | Satisfactory |
| 31 21 | 7 21 29 | Few months | Duodenal | Simple closure | Slight discomfort | 3-5-30 | Duodenal ulcer 1 8 30 | Returns regularly | Satisfactory |
| 32 36 | 9-2 29 | Few weeks | Pyloric | Simple closure | Weak and slight discomfort | 3 22 30 | Negative 3 7 30 | Returns regularly | Satisfactory |

TABLE VIII—CASES NEEDING A SECOND OPERATION

| No | Age | Date | History of gastric distress | Location of lesion | Type of operation | Course since first operation | Last seen | X ray | Follow up | Condition |
|----|-----|---------|-------------------------------------|--------------------|-----------------------|--------------------------------------------------------------------------------------|-----------|---------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------|--------------|
| 1 | 54 | 8-17-23 | 5 years | Pyloric | Simple closure | Slight discomfort with pyloric obstruction 2 to 10 days Gastro-enterostomy 4-5-10 | 8 x 10 | 3 to 10 one quarter of meal for meal ulcer fixed post cilia duodenum 10-9-20 negative | Returns regularly | Satisfactory |
| 2 | 43 | 4-8-26 | 1 year | Duodenal | Simple closure | Furrow pyloroplasty (C) abdominal pain 11-6-25 | 3 2 3 30 | Duodenal deformity 2 7 10 | Returns regularly no complaints | Satisfactory |
| 3 | 45 | 6-3-26 | 4 years | Duodenal | Hill key pyloroplasty | Gastro-enterostomy free pyloric obstruction 10-3-22 | 3-8 10 | Gastro-enterostomy almost normal 5-5-20 No retention or tenderness | Returns regularly no complaints | Satisfactory |
| 4 | 34 | 2-3-27 | None | Pyloric | Simple closure | C3 gastro-enterostomy free pyloric obstruction 12-2-27 | 2 4 18 | None since second operation | Social service 11-5-20-21-20 moved no address | Satisfactory |
| 5 | 26 | 5-24-19 | 5 years history of gastric distress | Duodenal | Simple closure | 1 in 10 at intervals since operation Needed second operation 1-10-30 for pain | 2 3 50 | Duodenal ulcer 2-3-30 | Does not return regularly Lives out of town Operated upon 1-10-30 for pain Gastro-enterostomy | Fair |

TABLE 1A—CASES PERFORATING WHILI UNDER MEDICAL CARE

| No | Age | Date | History of present illness | Local signs of lesion | Type of operation | Course since operation | Last seen | Follow-up | Condition |
|----|-----|---------|----------------------------|-----------------------|-------------------|-----------------------------------------------------------------|-----------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------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| 3 | 37 | 4-17-18 | 8 months | Typhoid | Simple closure | Admitted 11-11-18 with illad discomfort 6 weeks after operation | 12-24-18 | Duodenal ulcer 4-5-18, 4-10-18, 5-11-18, 6-11-18, 7-11-18, 8-11-18, 9-11-18, 10-11-18, 11-11-18, 12-11-18, 1-12-19, 2-12-19, 3-12-19, 4-12-19, 5-12-19, 6-12-19, 7-12-19, 8-12-19, 9-12-19, 10-12-19, 11-12-19, 12-12-19, 1-1-20, 2-1-20, 3-1-20, 4-1-20, 5-1-20, 6-1-20, 7-1-20, 8-1-20, 9-1-20, 10-1-20, 11-1-20, 12-1-20, 1-2-20, 2-2-20, 3-2-20, 4-2-20, 5-2-20, 6-2-20, 7-2-20, 8-2-20, 9-2-20, 10-2-20, 11-2-20, 12-2-20, 1-3-20, 2-3-20, 3-3-20, 4-3-20, 5-3-20, 6-3-20, 7-3-20, 8-3-20, 9-3-20, 10-3-20, 11-3-20, 12-3-20, 1-4-20, 2-4-20, 3-4-20, 4-4-20, 5-4-20, 6-4-20, 7-4-20, 8-4-20, 9-4-20, 10-4-20, 11-4-20, 12-4-20, 1-5-20, 2-5-20, 3-5-20, 4-5-20, 5-5-20, 6-5-20, 7-5-20, 8-5-20, 9-5-20, 10-5-20, 11-5-20, 12-5-20, 1-6-20, 2-6-20, 3-6-20, 4-6-20, 5-6-20, 6-6-20, 7-6-20, 8-6-20, 9-6-20, 10-6-20, 11-6-20, 12-6-20, 1-7-20, 2-7-20, 3-7-20, 4-7-20, 5-7-20, 6-7-20, 7-7-20, 8-7-20, 9-7-20, 10-7-20, 11-7-20, 12-7-20, 1-8-20, 2-8-20, 3-8-20, 4-8-20, 5-8-20, 6-8-20, 7-8-20, 8-8-20, 9-8-20, 10-8-20, 11-8-20, 12-8-20, 1-9-20, 2-9-20, 3-9-20, 4-9-20, 5-9-20, 6-9-20, 7-9-20, 8-9-20, 9-9-20, 10-9-20, 11-9-20, 12-9-20, 1-10-20, 2-10-20, 3-10-20, 4-10-20, 5-10-20, 6-10-20, 7-10-20, 8-10-20, 9-10-20, 10-10-20, 11-10-20, 12-10-20, 1-11-20, 2-11-20, 3-11-20, 4-11-20, 5-11-20, 6-11-20, 7-11-20, 8-11-20, 9-11-20, 10-11-20, 11-11-20, 12-11-20, 1-12-20, 2-12-20, 3-12-20, 4-12-20, 5-12-20, 6-12-20, 7-12-20, 8-12-20, 9-12-20, 10-12-20, 11-12-20, 12-12-20, 1-1-21, 2-1-21, 3-1-21, 4-1-21, 5-1-21, 6-1-21, 7-1-21, 8-1-21, 9-1-21, 10-1-21, 11-1-21, 12-1-21, 1-2-21, 2-2-21, 3-2-21, 4-2-21, 5-2-21, 6-2-21, 7-2-21, 8-2-21, 9-2-21, 10-2-21, 11-2-21, 12-2-21, 1-3-21, 2-3-21, 3-3-21, 4-3-21, 5-3-21, 6-3-21, 7-3-21, 8-3-21, 9-3-21, 10-3-21, 11-3-21, 12-3-21, 1-4-21, 2-4-21, 3-4-21, 4-4-21, 5-4-21, 6-4-21, 7-4-21, 8-4-21, 9-4-21, 10-4-21, 11-4-21, 12-4-21, 1-5-21, 2-5-21, 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have had acute perforated ulcers of the stomach or duodenum. All of these patients are males and their ages vary from 17 to 67 years, the average age being 39 years.

It was thought best to divide into three groups the cases that have been observed in the Gastro-Enterological Clinic. Group 3A, cases that have had one operation and are under observation, Group 3B, cases that have needed a secondary operation, Group 3C, cases that perforated while under medical management in the clinic. In each case the patient has been referred routinely to the Dental Department for X-rays and extraction when indicated, while those needing nose and throat examination and X-rays of their sinuses have been referred for that. Each case has been sent to the laboratory for a complete blood count, Wassermann, gastric analysis, urinalysis, blood chemistry for urea nitrogen, creatinine, sugar, chlorides, calcium and phosphorus determination. The laboratory findings will not be given in detail at this time.

Group 3A. These cases have been arranged according to year of perforation. It is not intended in this paper to draw conclusions as to what type of operation should be done, but merely to give the operative findings, the type of operation, and the condition of the patient when last seen. There are 32 cases in this group (see Table VII). Use of the terms "satisfactory," "fair," and "unsatisfactory" does not imply a cure or a failure. "Satisfactory" means the patient is able to carry on his daily routine. "Fair" means the patient is able to work but at intervals is incapacitated from the ulcer. "Unsatisfactory" means the patient is incapacitated from work as a result of the condition from which he is suffering. Of the 32 cases in this group, 22 were satisfactory, and 10 fair. There were no unsatisfactory cases although one perforation occurred 15 years ago, two 10 years ago, one 9, another 7, and four 5 years ago.

Group 3B. It was thought advisable to separate the cases that have needed secondary operations and to present the condition of the

patient when last seen. There are 5 cases in this series. From Table VIII it will be seen that 4 cases had a simple closure and 1 a pyloroplasty. In 3 cases the second operation was performed for scar tissue obstruction of the pylorus. One case went 5 years and 8 months before the second operation was performed, and the shortest case was 10 months following the first operation. Two cases were operated upon for pain. All of these cases are considered satisfactory since the second operation.

Group 3C. During the past 2 years there have occurred 6 cases of acute perforated ulcers in patients who were under medical care. On January 1, 1930, there were in the Gastro-Enterological Clinic 215 cases of ulcer. Of this number 37 had been operated upon for acute perforations before entering the clinic, and 41 cases had been operated upon for chronic ulcers before coming under our observation. This leaves 139 cases of unoperated upon ulcers that entered the clinic in 1928 and 1929, with 5 cases of acute perforations and one other case that had had one acute perforation and though under constant medical care perforated for the second time following the first operation. From Table IX it can be seen that one case was under treatment for 1 year and 9 months and became symptom free and the X-rays were negative for 7 months when his symptoms returned and he suffered a perforation. Another case had been treated for 1 year and a third for 10 months in the clinic but in both perforation occurred while under our care.

CONCLUSIONS

Patients suffering from a gastric or duodenal ulcer have a chronic recurring disease which may perforate after years of medical management. The fact that a patient has survived an operation for an acute perforation does not mean he is permanently cured, for that is not the case. These patients need constant medical supervision to obtain freedom from symptoms following operation and to diminish the chances of a second perforation.

EDITORIALS

SURGERY, GYNECOLOGY AND OBSTETRICS

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Chief of Editorial Staff

MARCH 1931

THE ELEMENT OF TIME IN GRADED OPERATIONS

IDEALISM in surgery is admirable, stimulating, and productive of advancement. Because of it, technical procedures are evolved and a better understanding of pathological conditions is reached. Idealism aims at extirpation or palliation of the effects of offending neoplasms, inflammatory lesions, or other conditions, in the shortest time compatible with sane and sensible effort. Nevertheless, in every field of surgery, it is amply demonstrated that this idealism, by adherence to which a complete maneuver is accomplished in one stage, must frequently be tempered by mature judgment, the result, often, of unhappy experience, and the more prosaic, uneconomic, and frequently uncomfortable operation in multiple stages must be done.

In surgery of the thyroid gland, prostate gland, stomach, large bowel, and rectum, graded procedures, as a step in the sequence of events, have aimed at eradication or relief of pathological conditions which affect these organs, indubitably have lowered the initial mortality rate, and have enhanced the ultimate

satisfactory outcome of operations on these organs. The tendency of every surgeon is to approximate the second stage of a graded maneuver as closely to the initial step as seems feasible, but here is a pitfall into which one is easily led and which, were it avoided as a routine by lengthening the time interval, would add somewhat, perhaps only a tiny fraction, to the reduction of mortality, without influencing the horizon of operability or negating the radicalness of the procedure at hand.

If one is convinced, in the presence of a bad risk in a case of goiter, that lobectomy is the operation of choice and that operation should be abandoned for the time being after removal of a portion of one lobe, certainly it seems sensible to delay resection of the other lobe for a period of more than 2 or 3 weeks, despite satisfactory improvement under vigorous postoperative treatment with compound solution of iodine, together with loss of some of the offending gland. There is the almost unavoidable temptation to proceed with the second stage, under the circumstances, after this period of time has elapsed, but perhaps a greater margin of safety can be obtained by delaying this stage for 3 months or for even a longer period.

Again, this is particularly true in surgery of the large bowel and rectum, in which, for many anatomical and pathological reasons, one frequently is inclined to employ graded attack on a malignant growth or a complicated inflammatory lesion. Although, unquestionably, in the majority of instances graded procedures can be carried out with confidence, in the interval of from 2 to 3 weeks, probably

greater advantage would accrue to a larger number of patients if a period of from 6 weeks to 2 months, or longer, were permitted to elapse. The ability to judge the patient's resistance and to allocate formidable procedures according to his ability to withstand them, unquestionably is the product of experience, and to err even occasionally in a large series of cases means an increase in the individual mortality.

In operations on the large bowel, the urgent necessity demanding operations in multiple stages for benign or malignant conditions, usually revolves around obstruction, acute or chronic, or concurrent disease affecting the general well-being of the patient. Combating either of these conditions to allow as near a return to normal physiological equilibrium as possible, and to raise the threshold of safety, while extending the opportunity for radical removal of the lesion and gland-bearing tissues in immediate juxtaposition to it, if the lesion is malignant, approaches the most desirable achievement. That this must be accomplished frequently with disregard of the economic situation of the patient, and of the protest of both patient and surgeon against prolonging convalescence is unquestionable, and yet, ultimately to accomplish either cure or prolonged palliation is the aim of all surgical procedures. If, then, by extending the time between stages, one may, without surgical disadvantage, extend the horizon of operability, decrease the immediate operative mortality, and thereby find encouragement to look for improvement in subsequent follow-up statistical data, it seems rational to disregard, from the economic standpoint, the time element in the majority of instances in the search for the optimal time for operation when graded procedures are indicated, and to increase the time interval beyond its accepted minimal limit.

FRED W. RANKIN

THE EARLY DIAGNOSIS OF ACUTE INTESTINAL OBSTRUCTION

SINCE the dawn of the era of abdominal surgery, a remarkable decrease in the mortality of acute abdominal disasters has occurred. No similar improvement can be boasted in the surgery of intestinal obstruction. Forty years ago internists and surgeons warmly debated whether cases of acute bowel obstruction should be treated conservatively or submitted to immediate operation. In 1888, acute intestinal obstruction was a major subject of discussion at the American Association of Physicians and Surgeons. Nicholas Senn presented the surgical aspects of the problem and Reginald Fitz the medical views, it was the consensus of the meeting that, when after 2 days of medical treatment no improvement had resulted, recourse should be had to operation. Today it is universally conceded that, when the diagnosis is made, the patient should be operated upon. Despite this general acknowledgment the results of operation for acute bowel obstruction are still deplorable.

In 1900, Gibson reviewed 1,000 cases of intestinal obstruction submitted to operation at various hospitals. The mortality was 43.2 per cent. VanBeuren and Smith, in 1925, published a collected report on 1,089 operations performed since 1900 with a mortality of 41.8 per cent. In every statistical study of bowel obstruction, however, it is apparent that the results of early operation compare favorably with those of other acute abdominal disorders.

Three factors contribute largely to late diagnosis in acute intestinal obstruction, viz., absence of local physical findings, the improper appraisal of enemas as a diagnostic criterion, and the irrational administration of morphine.

Unlike other acute abdominal emergencies, obstruction to the continuity of the intestine

presents neither local tenderness nor rigidity suggestive of the existence of a serious lesion within the abdomen. Obstructions presenting strangulation features in which hemorrhagic infarction of the bowel wall occurs in addition to interruption of the intestinal continuity, like purulent infarction of the appendix, produce signs of peritoneal irritation.

How many operations for acute intestinal obstruction are deferred because the administration of an enema is accompanied by the return of gas and feces? Every physician knows that the bowel distal to the site of obstruction is anatomically normal. Dogs with complete severance of the ends of the gut expel enemas with the return of gas and feces, when a small rubber balloon is placed in the loop distal to the obstruction, peristaltic activity of the same character as observed in the normal intestine is obtained and following the subcutaneous administration of eserin or intravenous infusion of hypertonic saline an increase in intestinal activity commensurate with the response of the normal dog's intestine follows. The bowel distal to the point of obstruction is therefore physiologically as well as anatomically normal. Why shouldn't patients with acute bowel obstruction expel gas on the administration of an enema? If the obstruction is partial, gas will be returned as long as enemas are given, in high and complete obstructions, until the gas in the bowel distal to the obstruction has been evacuated. Only in low complete obstructions is early information obtained through rectal irrigations.

An important item in the early recognition of bowel obstruction is the visualization of gas in the small intestine. Whereas gas is normally present throughout the intestinal canal it is visualized on the X ray film of the adult's abdomen in only the stomach and colon. The intimate admixture of gas and

fluid in the small bowel precludes its demonstration. During the first 2 years of life, gas may be regularly identified in the small intestine on the X ray film, but visible gas in the small intestine of the adult is synonymous with intestinal stasis. Within 4 to 5 hours after the establishment of simple obstruction in the dog, gas may be definitely visualized in the small intestine.

The stethoscope serves to distinguish whether the obstruction is mechanical or inhibitive (paralytic) in character. In the latter a profound stillness obtains or only an occasional faint sound is heard. In obstruction of mechanical origin loud intestinal noises concomitant with the height of the intermittent pain are easily audible. They persist even after pain has been assuaged by morphine. As fluid and air are hurried downward toward the point of obstruction by peristaltic rushes, their progress is suddenly arrested and fluid and air which were churned together in their advance tend to separate as the onward movement is halted. As the air rises to the surface, a sound like drops of water falling in a rain barrel or that occasioned by pouring water out of an inverted bottle with a narrow neck is produced. A metallic tinkle signifies that the bowel is under tension and is imparted only by a distended intestine. Visible peristalsis lends manifest confirmation but unfortunately is usually observed only in subacute and chronic obstructions.

Early in acute bowel obstruction there is no disturbance of the general body economy. The temperature is normal and there is no quickening of the pulse. Elevation of the blood urea, depletion of the chlorides, and alkalosis are observed even in high obstructions only after vomiting has continued for 48 hours and is not a sign to be awaited before the diagnosis is made. Regurgitant vomiting,

meteorism, and absolute constipation, like collapse and euphoria, are but sinister warnings that herald the approach of impending death

The occurrence of intermittent crampy, colicky, abdominal pain followed by nausea and vomiting but unattended by tenderness or rigidity suggests bowel obstruction. In no other acute abdominal disorder of a serious nature are local physical findings absent. If gas is visualized in the small intestine on the X-ray film and loud intestinal noises are audible over the abdomen synchronous with

the pain, the diagnosis of acute bowel obstruction may be confidently made. A patient suspected of having intestinal obstruction should be under hourly scrutiny and preferably in hospital. The persistence of intermittent pain, despite the return of gas with enemas, is adequate indication for immediate operative intervention. When patients with acute intestinal obstruction come early to operation, results long since obtained in the surgery of other acute abdominal disasters will be regularly recorded.

OWEN H. WANGENSTEIN

MASTER SURGEONS OF AMERICA

WILLIAM HENRY PANCOAST

WILLIAM HENRY PANCOAST, the son of Joseph and Rebecca Abbott Pancoast, was born in Philadelphia, October 16, 1835. His early education was obtained in the private schools of Philadelphia, he then entered Haverford College and graduated with the degree of A B, in 1853. Subsequently he received his A M, from the same institution. He began his medical studies with his father, Joseph Pancoast, and, after taking the regular course at the Jefferson Medical College, received his M D, in 1856. He then went abroad and spent two and a half years in study in the hospitals of London, Edinburgh, Paris, Vienna, and Berlin. "While in Paris he was a special student with, and often assistant of, the distinguished French surgeon Cuviale, who wished him to settle in Paris as his assistant, and offered to take charge of his future." Pancoast, however, declined this offer, and, returning to Philadelphia, commenced a general practice and devoted himself especially to surgery. He soon acquired a reputation as a brilliant diagnostician, a bold and skilful, but conservative, operator.

In 1859, soon after his return to Philadelphia, he was elected visiting surgeon to the Charity Hospital and held the position until his resignation at the end of ten years of service. He was then elected consulting surgeon and a member of the board of trustees. In 1862 he was made demonstrator of anatomy in the Jefferson Medical College and in the same year appointed a member of the Sanitary Commission doing valuable service during McClellan's disastrous campaign in the swamps about Richmond, Virginia. Returning to Philadelphia, he was stationed at the United States Military Hospital at the corner of Sixth and Master Streets. In 1866 he was elected one of the visiting surgeons to the Philadelphia Hospital.

In 1867 and 1868 during the absence in Europe of his father, Joseph Pancoast, he served as adjunct professor of anatomy, and in 1873 and 1874 he, for a second time, served as adjunct professor of anatomy. In 1874 his father resigned his professorship and he succeeded him as professor of anatomy and at the same time was made clinical professor of surgery. He resigned his professorship in 1886, intending to make a tour of the world, but before he could get away he became interested in the Medico-Chirurgical College, now the post graduate



WILLIAM H PANCOAST
1835-1897

school of the University of Pennsylvania Medical School, and was elected professor of general and surgical anatomy and clinical surgery, retaining active connection with this institution the remainder of his life

Dr Pancoast was the first president of the Alumni Association of the Medico-Chirurgical College and held the position for many years He was a member of the College of Physicians, Philadelphia, the Academy of Natural Sciences, Philadelphia, the American Philosophical Society, the various city, county state, and national medical societies, the Ordre Humanitaire de Mérite Civile in Paris

Dr Pancoast was twice married, first to Mary Ann Gertrude Lewis, and second to Charlotte Matilda Robb By his first wife he had three children, two daughters, and one son, William Howard Pancoast

In January, 1874, the Siamese Twins, Eng and Chang, died near Mt Airy, North Carolina, at the age of sixty-three years Under the auspices of the College of Physicians of Philadelphia, Dr Pancoast journeyed to Mt Airy and obtained the bodies on which he performed a necropsy This showed that the connecting band, situated near the navel, was a few inches long and eight inches in diameter The band consisted of skin, subcutaneous connective tissue and muscle, portions of the muscles of one crossing those of the other The interior of the band was occupied by prolongations of the peritoneum which crossed from one side to the other The livers of the twins were situated close to the connecting band and connected with each other by small blood vessels and a thin layer of liver tissue It is possible that the twins might have been separated in early childhood by division of the band, but in later life it would probably have been attended with fatal results

Dr Pancoast died January 5, 1897 He was greatly beloved by his students and friends It is said of him, that "His home was the center of hospitality and no medical gathering was quite complete without the presence of Professor Pancoast "

WILLIAM SNOW MILLER

THE SURGEON'S LIBRARY

OLD MASTERPIECES IN SURGERY

ALFRED BROWN M.D. F.A.C.S. OMAHA

THE SURGERY OF BRUNUS OF LONGOBURGO

AS the result of the instruction and publications of Roger Roland, and the four masters during the twelfth century and the early part of the thirteenth, surgery was well established in Italy and had also gained the ascendancy over medicine. That this ascendancy would last for a time and these men be followed by a group of outstanding surgeons, some of whom would migrate and carry with them the surgery of Italy to other countries, could easily be foreseen. Data concerning this group of surgeons are given by Guy de Chauliac in the introduction to his *Guidon* or Great Surgery where he cites them individually in chronological order. What he has to say about them and their work may as well be left out here for if it were quoted a doubt might be cast as to whether it is justifiable to write about any of them as Guy was nothing if not caustic in his criticisms. Guy de Chauliac places these men in the following order: Jamernus Brunus, Theodorich, William of Salicet, Lanfrancus, Arnold of Villa Nova, and Henri de Mondeville, and shows that they bridge the gap between the four masters and himself. Each of the men wrote a work on surgery which has come down to us, though the work of Jamernus has been found only comparatively recently. Each of them took much from their predecessors but also each of them added more or less of his own to surgery even though it might be only in a more clear and concise way of stating his information.

After Jamernus Brunus of Longoburgo was the earliest of the group. He was born in Longoburgo or Longobucco in Calabria and is sometimes called Brunus of Calabria. He probably received the major part of his education in Salerno though he is also supposed to have studied in Padua and Verona at that time two of the great medical centers of the world. He certainly spent some time in Padua for in the final paragraph of his *Great Surgery* he says that he has written his book "in the twelve hundred and fifty second year of the incarnation of the master among the citizens of Padua, in the place of Saint Paul." His minor surgery he does not date but the opening paragraph leads one to believe that it was written at the request of one Lazarus, of Padua, and is designed to complete the *Great Surgery* by amplifying the operative portion of the science.

Brunus' surgery appeared first in the *Collectio Chirurgica* I encia published in 1498 and has appeared in several subsequent collections. The volume from which the illustration is taken is the collection headed by the *Surgery* of Guy de Chauliac and printed by Gregorius de Gregorius in 1513. It is a small folio in which the *Great Surgery* occupies nineteen folios or thirty eight pages and the small surgery three and a half folios or seven pages.

In spite of the brevity of Brunus' work it is nevertheless important. It is the first surgical writer to accept the teachings of the Arabian school and endeavor to popularize them by teaching their ideas. He considers Albucasis the greatest of the Arabians in surgery and in this opinion he has been upheld by the majority of writers since his time. He makes no claim to originality as he says in his introduction that his work is "a book collected and excerpted from the teachings of the most glorious Galen, Avicenna, Almansor, Albucasis, and Haly Abbas and also other skilled men of the ancients." However he goes beyond their teachings and makes many original suggestions which were of value in the technique of surgery. In the suture of wounds for example he advises that the sutures be of silk preferably but if that is not at hand linen may be employed. The sutures should be placed one finger's breadth apart and the lower end of the wound be left open so that if it seems indicated "stuell" (probably drains) may be inserted so that bloody fluids may be discharged. In larger wounds with deep separation of tissues he lays stress upon the position of the extremity in order that drainage may be free. So he goes on through the surgery. Simple practical points are stressed and always from the standpoint of the surgeon who is to do the actual work, for Brunus believed that surgery was fully as important, if not more important from the standpoint of therapy than medicine, and that an individual who practised it demeaned himself not at all. In this connection one must remember that surgery was at this time becoming recognized as an important branch of medicine, and Brunus was one of the earliest to start the movement which was to lead to the formation of the surgical guilds which were to dominate surgical practice for centuries and wage constant warfare for the recognition of surgery as an independent science and not a trade.

REVIEWS OF NEW BOOKS

THE book *Diseases of the Urinary Tract in Children*¹ written in monographic form is based on rather extensive experience mostly in the wards of Mt Sinai Hospital, New York. It is an excellent example of hospital co operation between the departments of pediatrics and urology and shows what the fruits of this type of co operation may be.

General symptoms and the various methods of examination are briefly but clearly presented. The chapters on enuresis, infections of the urinary tract, abscess and carbuncle of the kidney, foreign bodies in the urinary tract, congenital anomalies of the upper urinary tract, urinary lithiasis, chronic renal tuberculosis, injuries, and tumors leave nothing to be desired in the matter of thoroughness.

Attention should be called to the chapter on pyelitis because not only is it well written but it presents, in a concise form, the views as we know them today. Malignant tumors of the kidneys, always an interesting subject, are discussed from the various angles which make for enlightenment, and the different theories of the origin of kidney tumors in children are not neglected.

The pediatrician especially and also the general practitioner should be interested in the chapters dealing with disturbances in the outflow of urine from the bladder, obstruction at the neck of the bladder, and in the urethra, and diverticulum of the bladder—subjects which hitherto have received but scant attention in the literature.

It goes without saying that this book, dealing as it does with diagnosis, pathology, and treatment, should prove of exceeding value to the general practitioner who, as a rule, sees these cases first, to the pediatrician who has not always been fully trained in urology, and to the urologist whose work has been wholly or almost wholly confined to the adult.

The book is profusely illustrated and each chapter contains an excellent bibliography.

H. L. KRETSCHMER

A COLLECTION of the well known papers of Drs C H Lawrence and A W Rowe that have appeared in the course of the past ten years is found in the book entitled *Collected Publications from the Robert Dawson Evans Memorial for Clinical Research and Preventative Medicine*². The method of study is unique, being statistical and complex. The section on the thyroid is typical. It consists of tabulated data of observations of physical measurements, vital capacity, urine studies, blood chemistry, blood morphology, respiratory metabolism, and galactose tolerance, a clinical section reporting 100 cases of

thyroid failure of which the data are also tabulated, and a number of groups of case reports. This volume will serve as a useful reference work for those studying endocrine disorders.

PAUL STARR

CROSSEN'S *Diseases of Women*³ is a standardized text familiar to all. The revised seventh edition includes the newer methods of diagnosis and treatment of gynecological conditions presented in the past several years.

The text, which comprises over 1,000 pages and approximately 950 illustrations, is interesting and easy reading, the illustrations are instructive and exceptionally well done.

This book is an excellent text for the student of gynecology and an ideal reference for the practitioner.

E. A. EDWARDS

IN his *Urologie Pratique*⁴ Dr P Bazy has put into 467 pages the urological facts which might be of use to the general practitioner, he has done this without burdening the book with long dissertations.

In general, the author believes that urinary antiseptics have such short contact that their value is questioned, he uses boric solution for lavage and salol internally. It is stated that electrolysis in the treatment of urethral strictures has been given a fair trial and found to have no value. Dr Bazy also believes that Maisonneuve's urethrotome cuts and damages too much of the healthy urethra, so he has devised a urethrotome to avoid this. It is interesting to note that this writer believes all gonorrhoeal urethritis becomes posterior by the fourth day of the disease. In his discussion of urinary tuberculosis, he states that the origin of the disease is always in the kidney.

In agreement with American teaching, Dr Bazy writes that in bilateral obstructive anuria, the healthiest kidney should be operated upon first. Attention is called to the fact that a ureter often has a larger caliber than the urethra—this is to be kept in mind when one is using the watchful waiting policy in the treatment of ureteral stones.

Dr Bazy emphasizes over and over that much acute urinary retention can be ascribed to cystitis rather than to the mechanical obstruction of a prostate or stricture, he argues that retention from a stricture is due to a spasm of the bladder rather than to mechanical obstruction.

The section on hæmaturia is very interesting and instructive, his advice to examine cystoscopically a patient who has hæmaturia when he is not bleeding will not be agreed to by many American workers.

HARRY CULVER

¹ DISEASES OF THE URINARY TRACT IN CHILDREN. By Edwin Beer M.D. and Abraham Hyman M.D. New York: Paul B. Hoeber Inc. 1930.

² COLLECTED PUBLICATIONS FROM THE ROBERT DAWSON EVANS MEMORIAL FOR CLINICAL RESEARCH AND PREVENTATIVE MEDICINE. No. 1. ENDOCRINE STUDIES. Boston: F. J. Barnard & Company Inc. 1929.

³ DISEASES OF WOMEN. By Harry Sturgeon Crossen, M.D., F.A.C.S. and Robert James Crossen. M.D. 7th ed. rev. St. Louis: The C. V. Mosby Company. 1930.

⁴ UROLOGIE PRATIQUE. By Dr P. Bazy. Paris: Gauthier Villars et Cie. 1930.

IN his book on *Nursing in Emergencies* Berman's definition of first aid treatment is somewhat confusing. He divides emergencies into two classes: surgical and medical. Under medical cases he includes "those evolved without trauma or external force." He then lists twelve conditions producing unconsciousness and instructs the nurse in recognizing and differentiating these conditions and in treating them. He shows "how dependent rational treatment is upon an accurate diagnosis." But that this "to say the least requires the skill and knowledge of a competent physician."

I think it is safe to say that no institutional nurse would be permitted to give hypodermic injections of morphine or digalolin or to use a stomach pump without an order from a doctor or without previous agreement as to her authority to handle such situations. Usually organizations employing first aid workers have physicians in charge who have their own ideas about the nurses' equipment and dictate accordingly. Such a nurse is told what her duties consist of. It is probable that a nurse might get herself into serious difficulty were she to give digalolin upon her own diagnosis without previous instructions from a physician. Any advice which Dr. Berman

may give in his book about what the physician should do seems beside the point. For a nurse to know when these medications and treatments are indicated is important. For her to understand and accurately appreciate a situation may save life. Telephones are not rare and orders may be received and carried out in this way if the nurse is able to explain intelligently to the physician.

The list of poisons and their antidotes which Dr. Berman gives in chapter three, is strictly first aid care and for nurses who meet with such situations more or less regularly it is wise of them always to carry with them such a list. Any nurse should be familiar with the more common forms of poisoning such as alcohol, morphine, bichloride, arsenic, turpentine.

A large part of the book gives such information as nurses commonly get who are graduates of class A nursing schools. Such information is given in courses on surgical nursing, obstetrics, clinic work, and public health.

There is much of value in Dr. Berman's book, but the information is so mixed with medical and surgical treatments and nursing care of surgical cases that the pertinent facts concerned with emergency work as I understand it lose significance in the mass of other detail. F. D. J.

NURSING IN EMERGENCIES By Jacob K. Berman, A.B., M.D.
F.A.C.S. St. Louis: The C. V. Mosby Company, 1929.

BOOKS RECEIVED

Books received are acknowledged in this department and such acknowledgment must be regarded as a sufficient return for the courtesy of the sender. Selections will be made for review in the interests of our readers and as space permits.

INTESTINAL TOXEMIA (AUTOINTOXICATION) BIOLOGICALLY CONSIDERED By Anthony Bassett, M.D., F.A.C.P. Philadelphia: F. A. Davis Company, 1930.

LA NOUVELLE MATERNITÉ GYNÉCOLOGE CLINIQUE OBSTÉTRICALE DE LA FACULTÉ DE MÉDECINE DE L'UNIVERSITÉ DE PARIS Directed by Prof. Alexandre Couvelaire. Paris: Masson et Cie, 1930.

PHYSICAL DIAGNOSIS By Warren P. Elmer, B.S., M.D. and W. D. Rose, M.D. St. Louis: The C. V. Mosby Company, 1930.

MEDICAL JURISPRUDENCE: A STATEMENT OF THE LAW OF FORENSIC MEDICINE By Elmer D. Brothers, B.S., LL.B. 3d ed. St. Louis: The C. V. Mosby Company, 1930.

OPERATIVE GYNÉCOLOGY By Harry Sturgeon Crossen, M.D., F.A.C.S., and Robert James Crossen, M.D. 4th ed. St. Louis: The C. V. Mosby Company, 1930.

TRANSACTIONS OF THE AMERICAN GYNÉCOLOGIC SOCIETY, THIRTY FIRST ANNUAL SESSION Held at Hotel Statler, Buffalo, New York, June 22d, 23d, and 24th, 1930. Reading, Pennsylvania: Reading Eagle Press.

GLASGOW ROYAL MATERNITY AND WOMEN'S HOSPITAL MEDICAL REPORT FOR THE YEAR 1929 Prepared by J. N. Cruickshank, M.D., F.R.C.S. (Glas.), M.A.C.C. (Lond.). Glasgow: Aird & Coghill Ltd., 1930.

WILLIAM STEWART HALSTED SURGEON By W. G. MacCallum. Introduction by Dr. W. H. Welch. Baltimore: The Johns Hopkins Press, London: Oxford University Press, 1930.

TREATMENT OF TUBERCULOSIS By Fritz B. Talbot, M.D. New York: The Macmillan Company, 1930.

CHRONIC ARTHRITIS AND RHEUMATOID AFFECTIONS WITH RECOVERY RECORD By Bernard Langdon Wyatt, M.D., F.A.C.P. With the Collaboration of Louis I. Dublin, Ph.D., and Foreword by Dr. J. Van Breemen. New York: William Wood and Company, 1930.

METHODS AND PROBLEMS OF MEDICAL EDUCATION (EIGHTEENTH SERIES) New York: The Rockefeller Foundation, 1930.

HERSOL'S HUMAN ANATOMY, INCLUDING STRUCTURE AND DEVELOPMENT AND PRACTICAL CONSIDERATIONS, 9th rev. ed. Under the Supervision of G. Carl Huber, M.D., Sc.D. Philadelphia: Montreal: London: J. B. Lippincott Company, 1930.

PRACTICE OF SURGERY Edited by Dean Lewis, M.D. Sc.D. Vol. III: Bones and Joints (cont. d.), Muscles, Tendons, Nerves, Brachial Plexus, Sympathetic Nerves, Lymphatics, Amputations. Vol. IV: Eye, Ear, Nose, Mouth, Jaw, Salivary Glands, Pharynx, Larynx, Trachea, Thorax, Esophagus, Mediastinum, Heart, Pericardium. Vol. V: Pulmonary Tuberculosis, Pulmonary Suppuration, Massive Collapse of Lung, Tumors of Chest, Mammary Glands, Diaphragm, Plastic Surgery, Hand. Vol. VI: Lungs, Liver, Bile Passages, Appendicitis, Intestinal Tract, Rectum and Anus, Intestinal Obstruction, Intestine, Hernia. Hagerstown, Maryland: W. F. Prior Company, Inc., 1930.

ENGLAND'S PERCENTENARY CELEBRATION AND INITIATION AT THE WELLCOME HISTORICAL MEDICAL MUSEUM Henry S. Wellcome, LL.D., F.R.S., Director. L. W. G. Malcolm, M.Sc. (Cantab.), F.R.S. London: The Wellcome Foundation Ltd., 1930.

SURGERY, GYNECOLOGY AND OBSTETRICS

AN INTERNATIONAL MAGAZINE, PUBLISHED MONTHLY

VOLUME LII

APRIL, 1931

NUMBER 4

PRIMARY MALIGNANT TUMORS OF THE URETER

M. J. RENNERT, M.D. NEW YORK

From the Institute of Pathological Anatomy of the University of Vienna. Professor Dr. R. Maresch, Director.

MALIGNANT growths which secondarily involve the ureters are conditions with which the pathological anatomist is quite familiar. They are especially common in cases of advanced carcinoma of the uterus. Occasionally also in the presence of a primary carcinoma of the abdominal viscera, the ureter is compressed from outside by carcinosis of the peritoneum or by metastatic involvement of the abdominal lymphatic glands, or perhaps the ureter may even become infiltrated. However, it is a well known fact that for a considerable time the wall of the ureter will resist involvement by the tumor (Wertheim). Metastatic nodules in the ureter occur very rarely but when present usually arise from the lymph stream. As a rule in the cases of secondary malignant growth the clinical diagnosis offers no difficulty when the lumen of the ureter has become constricted, but if the growth is primary in the ureter the diagnosis proves much more difficult. Up to the present time diagnosis has been accurate only in the minority of the cases examined. Thus it is easily appreciated that, from a clinical point of view, primary growths of the ureter are of great importance since a cure may be obtained by timely surgical treatment (ureterectomy, nephrectomy).

Among the *primary growths* of the ureter, the non malignant villous growths similar to those of the renal pelvis and bladder, are

most frequently observed and very often occur simultaneously. Cases of generalized papillomatosis of the urinary passages should, according to Stoerk, on no account be considered as neoplastic but rather as chronic inflammatory hyperplasias. At any rate, reference to these non-malignant villous growths of the urinary passages seems to be justified because malignant epithelial growths undoubtedly can develop from them. Apart from this, it will be necessary to revert to this question in discussing some of the epithelial neoplasms of the ureter mentioned in the literature.

Among the *primary malignant growths*, carcinoma is the most common. Rayer (1842) was the first to observe primary carcinoma of the ureter and Chian (1916) found 17 cases described in the literature. Since then the number of cases has been tripled, so that it may now be assumed that about 50 cases of primary carcinoma of the ureter have been reviewed. Among the cases described, the majority were papillary, while the remainder were of solid growth.

With reference to the mesenchyme growths of the ureter, primary tumors of the connective tissue occur, such as myomata and fibromyomata (Kaufmann, Weinstock, etc.), but these are much rarer than carcinomata.

Mixed tumors are never found in the ureter but they have occurred in the renal pelvis while carcinosarcomata have been found in the bladder.

We propose to describe a recent case of primary malignant tumor of the ureter for the following reasons: first, this case seems to be of exceptional interest, especially since exact cystoscopic and radiological data are available; second, there is the exceptional anatomical condition which, as we shall see later, led to an erroneous clinical diagnosis of the primary growth in the bladder, and third, because the microscopic structure of primary malignant neoplasms of the ureter has, heretofore, never been observed.

In this case the patient was a man 71 years of age. Postmortem examination was made in the Institute of Pathological Anatomy of the University of Vienna on June 15, 1929.

Gustavus S., 71 years old, entered the clinic on May 12, 1929. He had had gonorrhea at the age of 30, dysentery and articular rheumatism in 1917. He had had no urinary trouble of any kind until suddenly, on May 4, 1929, blood appeared in the urine. The bleeding became more and more severe, with strangury and pains during micturition. Treatment consisted in the washing of the bladder with sodium bicarbonate. As there was no improvement the patient was admitted to hospital.

Examination at this time showed that there was no point which was painful to pressure in the region of the kidneys, but on the right side there was a point of resistance on palpation. The urine was cloudy and mixed with blood. Albumin was definitely present and sugar absent. In the sediment were plenty of erythrocytes, leucocytes and epithelial cells.

The bladder could be washed out quickly. It had a small capacity. Cystoscopically no diagnosis could be made because a red disc always appeared.

X-ray examination was made by Dr. Haslinger. A flat plate of the urinary bladder showed nothing exceptional. When the bladder was filled with air or contrast solution an indistinct rim about $1\frac{1}{2}$ inches in width was seen. This rim could not be caused either by the contained air or by the sodium bromide alone. In the center of the bladder cavity there was a symmetrical dense shadow (Figs. 1 A and B).

Suprapubic cystotomy was performed on May 24, 1929, and a tumor about the size of an apple, nodular but comparatively soft and having a thin pedicle, was excised from the region of the trigonum. After the operation the condition was at first satisfactory, then anuria and a condition of semiconsciousness supervened. On June 14, 1929, the patient died with signs of uræmia.

K. Haslinger reported on the clinical and A. Feiler on the anatomical diagnosis of the case at the meeting on July 3, 1929, of the Wiener urologische Gesellschaft. The history of this case, together with the X-ray pictures, was very kindly placed at our disposal by the director of the 2d surgical clinic of the university, Professor Dr. Hochengruber, to whom thanks are herewith expressed.

Clinical diagnosis. The diagnosis after high section and extirpation of the sarcoma of the urinary bladder was: neoplasm of the right kidney, cirrhosis of the kidney, uræmia, and bronchopneumonia.

Macroscopic examination of the extirpated tumor of the bladder (Fig. 2) showed a spherical tumor measuring 7 by 4 by 3.5 centimeters in its longest diameters. In the place where the excision was carried out a stem about 1 centimeter in length and 2 to 3 centimeters in diameter was disclosed. The stem emanated from a hilum like contraction on the surface of the tumor. Otherwise the surface of the growth was fairly smooth and was mostly of a dark red color. In places the continuity of surface had been disturbed by the shedding of superficial parts of the tumor, and these due to necrosis possessed an indistinct muddy color. On section, the growth consisted partly of a whitish gray homogeneous mass of fibrous tissue and to a larger extent of a dark red tissue equally structureless but some what more soft and spongy.

Microscopic examination revealed in several pieces taken from the various parts of the growth whitish well preserved particles, which consisted throughout of a fibrous stroma very rich in vessels. In some parts there was an anomalous arrangement in others a fascicular structure (Fig. 3). In this stroma of varying density, large spindle cell elements were found. These showed distinct polymorphism and polychromatophilia in addition to numerous mitotic figures. In the superficial parts of the growth which showed this structure throughout, an infiltration of polymorphonuclear leucocytes with various necrotic areas was found. Toward the depths of the tumor one could see how the spindle cell elements of the tumor were fascicularly arranged and were in many places, already forced apart. Thus the fibrous structure of their interstitial substance became more and more indistinct, showed gaps, and in many cases stained light blue with hematoxylin. The blue coloring became slowly more distinct as the structure of the interstitial substance became more granular, at the same time the spindle formed cell elements slowly disappeared, giving place to starry forms, so that in the large parts the character of myxomatous tissue was obtained (Fig. 4). As a third type of tissue, small irregularly shaped areas were found. These were surrounded by nearly structureless spindle cell tissue. They stained pink with eosin and contained roundish cells in fairly irregular order. These were sharply defined and looked like cartilage cells (Fig. 5). Moreover the considerable amount of polymorphism and polychromatophilia was noted in the cells and in places there was a deposit of calcium in the cartilage areas.

In the section examined there was also found a fairly extended but localized hyalinization.

Sections from the macroscopic parts of the red portion of the tumor show an exactly similar structure with an extraordinary richness of vessels, they were, however almost necrotic. The vessels of these regions were often filled with layers of thrombi.



Fig 1A Roentgenogram of the urinary bladder filled with air



Fig 1B Roentgenogram of the urinary bladder filled with sodium bromide

The elementary substance however, reverted to a myxomatous condition. In several places in the necrotic parts of the tumor, irregular calcified areas could be found, which partly reminded one of spicules of bone.

With the staining of collagen fibrils, according to Bielschowski-Maresch and Mallory, a very dense and fine plexus of fibers were found in the spindle cell parts of the tumor. This enclosed the several cell elements while the meshes of the network became larger and looser in the myxomatous regions. The cartilage areas were surrounded by a dense fibrous structure like a perichondrium. In the elementary substance of the cartilage itself, however, only a very delicate network could be found.

These findings would indicate the presence of a spindle cell sarcoma of large cells, rich in vessels, with an extensive change toward a myxomatous condition, with areas of necrosis and cartilage formation.

At the postmortem examination (Assistant Dr Feller), the following was ascertained:

Genito-urinary tract. The anterior wall of the urinary bladder, near the top, was fixed to the abdominal wall and there, above the symphysis, a urinary fistula—large enough to allow the passage of the little finger—was present (Fig 6). The urinary bladder itself was comparatively small, thick walled, and hypertrophic. The muscularis mucosae

was also thickened and intensively injected. Near the orifice of the right ureter, a pedicle of tumor tissue, a few millimeters in length, was protruding. It was somewhat irregular in shape and about the thickness of a thin lead pencil. On opening the right ureter, which throughout its length was large enough to admit one or two fingers (increasing in size as it approached the renal pelvis) its lumen was found to be filled with tumor tissue. This was sausage shaped, cylindrical in form, grayish white in color, and in places was permeated with blood. Approximately at the junction of the upper and middle thirds of the ureter, the substance of the tumor was adherent to the posterior wall over a certain area, otherwise it showed a smooth, free surface. Toward the top of the sausage shaped tissue, the tumor ended in the shape of a hook, bent outward and posteriorly, about 3 centimeters below the renal pelvis. In the downward direction, the tumor became smaller, conically toward the orifice of the ureter and showed in place of the latter, a circular constricted groove, to which the previously mentioned pedicle was attached and from which it reached into the urinary bladder.

Above the upper end of the tumor substance, the right ureter was bigger in diameter than the size of two fingers and ended in a membranous pouch, larger than a child's head. This corresponded to the right renal pelvis, which upon being opened was found to contain about half a litre of thin, brownish



Fig. 2. Tumor of the urinary bladder removed at operation. It corresponds to the vesical end of the growth of the right ureter. Natural size.

fluid. The calyces were changed into large cystic cavities showing wide communications with the sac shaped renal pelvis. One of the calyces at the upper pole of the right kidney was especially big and cyst-like and was lined with a brownish material. The parenchyma of the kidneys had been thinned down to a few millimeters by the protrusion of the cyst-like calyces.

The left kidney was slightly enlarged and on its surface a large number of abscesses could be seen arranged in groups and about the size of millet seeds. Corresponding to these a large number of yellow streaks were noticed in the region of the renal pyramids. The pelvis of the left kidney was moderately enlarged reddened and filled with pus. The left ureter was also somewhat wider than usual its muscularis mucosae being reddened and containing some pus in its lumen.

Other organs. Apart from the signs of urinary a luetic mesoarteritis and extended bronchopneumonia of both inferior lobes were found.

Microscopic diagnosis. For the histological examination a slice of the ureteral tumor was taken together with the ureteral wall at the site of the growth. The numerous sections which were made were stained with hematoxylin-eosin according to van Gieson Mallory Bielschowski Maresch and according to Gram Weigert with thionine for fibrin. Figure 7 is an enlarged photomicrograph of a section from the slice mentioned. The wall of the ureter was cut longitudinally anteriorly during the post mortem examination was unfolded and stretched to a slight degree its still normal anterior parts could no longer be seen in the picture. Adjoining the parts of normal muscularis mucosae we found in the left half of the picture in place of the muscularis mucosae a papillary tumor with disintegrating surface. Figure 8 is a still greater enlargement. In this picture in a very fine stroma rich in vessels epithelium of the transitional type is seen. The cells are arranged in many rows and show distinct polymorphism and polychromatophilia. Next to these flat villous parts of the growth which throughout occupied only the region of the ureteral muscularis mu-

cosa and did not penetrate into the muscularis we found a large part of the growth which in the figure showed a roundish form (Fig. 7). The central parts were extensively hyalinized and consequently stained red with van Gieson's stain while the preserved parts situated nearer to the surface showed in places the structure of a fairly polymorphous spindle cell sarcoma with a moderate number of giant cells and in other places while retaining their sarcomatous character appeared to be distinctly myxomatous. Reproduction of the pictures of these parts of the growth appeared unnecessary as in every respect they were similar in those which had been already described in connection with the extirpated bladder tumor. In the hyaline central portion small islands of hyaline cartilage, similar to that in the tumor of the bladder, were found. While most of the sarcomatous parts of the growth were situated above the muscularis without penetrating it we could distinctly observe in the right half of Figure 7 how a wedged shaped peg like process of the growth which was principally myxosarcomatous penetrated between the layers of the muscularis splitting it like a fork. The border line between the epithelium and sarcomatous part of the growth was of particular interest because cancer vessels could be noticed in the middle of a sarcomatous stroma (Fig. 9). In connection with special stains, it should be mentioned that with silver impregnation according to Bielschowski Maresch a very fine network of fibrous tissue surrounding the individual cells of the tumor can be demonstrated in sarcomatous spindle cell and myxomatous parts, while in the epithelial parts of the growth fibers capable of impregnation are found only in the delicate stroma.

With Mallory's stain the same conditions may be observed in the collagen fibers.

With thionine the elementary substance in several regions of the myxosarcomatous parts of the growth may be stained a dark red. The elementary substance of the cartilage stains a light pink.

According to Gram Weigert several myxomatous portions of the growth and the cartilage islands stain bluish similar to the staining with thionine here and there delicate reticula of fibrin may be seen quite superficially in the parts of the growth which have undergone a degenerative change.

The histological examination of the hydronephrotic and hamatonephrotic right kidney showed that the parenchyma of the kidney had changed into a sac only 2 to 3 millimeters thick. This sac consisted partly of hyaline callus tissue in which renal elements could no longer be recognized, while in places the glomeruli which had completely changed into connective and hyaline tissue could still be recognized as a remnant of the kidney parenchyma. The reddish brown substance which was mentioned in the microscopic description is having been found in the enlarged cyst like cavities proved to be layers of old blood. Upon examination several sections of these small islands of myxosarcomatous tissue in the tumor were ascertainable.

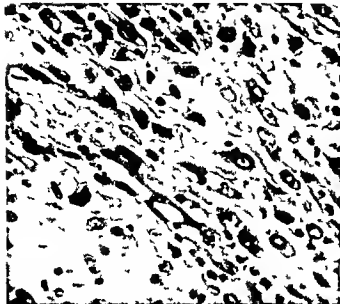


Fig 3 Photomicrograph of section of removed bladder tumor, note spindle cell sarcomatous tissue

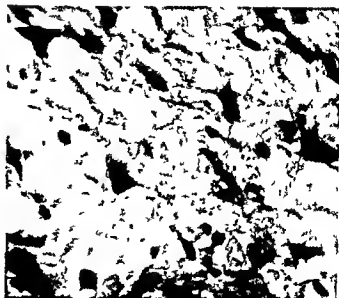


Fig 4 Photomicrograph showing myxosarcomatous tissue

In conclusion, we have here a man, 71 years of age, who, apparently in good health, without any previous urinary trouble, suddenly had hematuria 6 weeks prior to his death. As the cystoscopic diagnosis and the X ray examination indicated a tumor of the bladder, suprapubic cystotomy was carried out 1 month before death. A pedunculated growth, resembling a fibroma and about the size of an apple, was removed from the fundus of the bladder. The spherical form of the bladder tumor, which could be seen from the X ray picture and the macroscopic photograph and the very clear definition of the growth, which latter appeared to be attached by a thin pedicle in the trigonal area, should explain why the existence of a tumor of the ureter was not thought of at first. It is true that after the operation, a tumor of the right kidney was discovered by palpation, but it was difficult to decide on a second operation. After a period of improvement, the patient died of uremia.

The microscopic examination of the extirpated bladder tumor resulted in the diagnosis of sarcoma, mainly spindle cell, with an extensive myxomatous change and in some places cartilage formation was present.

At the autopsy, the primary tumor of the right ureter was found, which, emanating from about the middle of the posterior wall, nearly filled the lumen completely with its sausage like form. Extending upward, it reached almost to the renal pelvis and in a downward direction, through the ureteral orifice, reached into the urinary bladder. At the site of removal of the bladder tumor, a pedicle about 2 to 3 millimeters in diameter, was found. This protruded from the orifice of the right ureter.

The histological examination of the ureteral tumor showed that it was composed of small flat portions which were adherent to the wall of the ureter and

resembled a papillary carcinoma in type. The large sausage shaped part of the tumor which filled the lumen of the ureter was sarcomatous and corresponded in structure to that of the urinary bladder tumor in every respect. Apart from the myxomatous portions, it contained the same small islands of cartilage as did the latter. The epithelial and sarcomatous parts of the growth were not only situated next to one another, but penetrated each other so that in places cancer alveoli were found in a sarcomatous stroma. The primary tumor of the ureter must therefore be designated as a *carcinosarcoma*, the sarcomatous component of which showed much proliferation and was the largest part of the sausage shaped ureteral tumor and the tumor of the urinary bladder, which had been removed. To express the exact structure of the growth in a precise manner, one might call the primary tumor of the ureter, a *fibromyxochondrocarcinoma*.

In the right kidney, the typical diagnosis of hydro-nephrotic atrophy could be ascertained microscopically. The bleeding (hematonephrosis) was sufficiently explained by the microscopic diagnosis of cells of the tumor in the blood effusion of the renal calyces, and presumably had been caused by degenerative metamorphosis of tumor tissue which had settled there. The tumor elements had reached there without doubt, because small portions of the ureteral growth had been dammed back in the urine, and in this way had been implanted in the renal pelvis.

The tumor of the ureter which had been described was therefore quite an exceptional one both as regards its macroscopic anatomical condition and as to its microscopic structure. It could, therefore be appreciated that a complete clinical investigation of this case offered considerable difficulties. We may consider it from every point of view as a case which stands alone in the literature.



Fig 5 Photomicrograph showing sarcomatous tissue with cartilage formation

If we compare this case with those of primary malignant growths of the ureter which have already been published we find as already mentioned at the beginning of this treatise, that carcinomata are most frequently encountered. It is not necessary to give a detailed statement here, in respect to these primary carcinomata of the ureter, as such a statement, prepared with much care and given in a clear scheduled form was published by Rousselot and Lamon in January, 1930. However, both the authors have avoided a critical discussion of their compilation and have not arrived at any conclusions in connection with their material.

It might, therefore, be advisable to emphasize a few facts.

The published cases, enumerated by Rousselot and Lamon number 49. A critical discussion of the literature in question, by Glas (1926), points out, that from this number, the case of Chevassu and Mock (1912) and the case of Foupet and Guenot (1898) can be eliminated, as the former represents a case of non malignant papilloma of the ureter, and the latter a tumor of the renal pelvis which had extended into the ureter. The communications of Hofmann and Finsterer (1915 and 1916), respectively numbered 24 and 26, have erroneously been counted as 2 cases, although they each

refer to one and the same case. Of the compilation of Rousselot and Lamon, 46 cases remain, therefore. If to this number we add the case described by the authors themselves and the new case of Player (1928), which is not mentioned, we have a series of 48 cases of primary carcinoma of the ureter.

As regards localization it will be found that out of these 48 cases, 32 (i.e., two thirds) of the total have emanated from the lower half of the ureter, 5 from the middle portion, and 6 from the upper half.

In 6 cases of the first group, the growth had penetrated through the orifice of the ureter into the urinary bladder and was visible by endoscopic examination of the bladder.

As regards sex, the cases may be divided almost equally—23 males and 25 females.

A combination with urinary concretion was found in 7 cases only (12.5 per cent).

As to histological structure, papillary carcinomata were most frequent, 19 in all (i.e., 40 per cent), of all cases considered, solid carcinomata occurred 11 times (23 per cent). Besides these, a cylindrical cell carcinoma was mentioned once, an adenocarcinoma once, a transitional cell carcinoma twice, and a pavement epithelium carcinoma five times (i.e., 10.4 per cent of the cases). In the remainder of the cases, there is no histological diagnosis, or merely a designation as carcinoma without any classification.

Non malignant papillomata, in addition to the primary carcinomata of the ureter, are found, in the case of Israel, in the surroundings of the carcinoma of the ureter, in the case of Poll, in the renal pelvis and the whole of the ureter, and in the case of Player, in the urinary bladder. These cases are certainly interesting from the point of view of showing that carcinomata can arise from non malignant papillomata (Stoerk). The opportunity must be taken, however, to oppose the view which was apparently expressed for the first time by Israel (1910) and was adopted even more recently by Glas and Player, that primary carcinoma of the ureter or renal pelvis can cause metastases which bear "the character of a simple papilloma" (Israel) and only subsequently become carcinomatous. Glas even finds that this occurrence is "not



Fig 6 Postmortem specimen of the whole urinary apparatus. The right kidney is hydronephrotic. The right ureter in its lower two thirds is filled with a tumor, about the thickness of a finger.

rare" and Player, in his recapitulation, states literally "a benign papilloma may be the metastasis of a malignant ureteral carcinoma."

It is evident that, in the cases of which the authors speak, it must have been a question, either of primary multiple papillomata (papillomatosis), in which several of the villous tumors have already become cancerous, while in others their benign character has been retained, or it is also possible that subsequently and quite independently of the carcinoma, benign papillomata have developed. The processes, assumed by Israel, Glas, and Player, could not possibly be brought into agreement with the views which we hold in regard to malignant tumors.

Sarcomatous growths of the ureter are much more rare than the carcinomatous growths. Ribbert described, in 1886, a



Fig 7 General microscopic picture of the ureter, the cross section being cut at the point of origin of the tumor from the ureteral wall.

spindle cell sarcoma which he had found in a girl of 4 years of age, it arose primarily from the renal pelvis and from the ureter and showed numerous layers of transversely striated muscular fibers. The latter fact, he has explained by metaplasia of smooth muscle, the former he inferred came from connective tissue of the urinary passages.

Ku (1925) has described a fibromyoma which he saw in a man, 71 years of age. The growth arose from the lower third of the ureter and its muscularis was described as being partly split up. The growth was accounted for by the layer of circular muscle in which a malformation of tissue of the embryomyoma type was assumed to be the point of origin of the growth. In support of this assumption of congenital malformation of tissue, which later leads to a tumor-like development, the simultaneous existence of multiple lipomata and of a pneumomycosis osteoplastica racemosa was deduced.

Lichtheim and Willutzky have described alveolar sarcomata of the ureter, Heller (1920) have described spindle cell sarcoma of the ureter (Bachur). In recent years, Neuwrth (1928) has described a spindle cell sarcoma about the size of a walnut, which he observed in the lower third of the ureter in a man of 60 years of age.

A case, reported by Binder, has not been mentioned here, this was a spindle cell sarcoma but appeared to belong to the account of the structure of the ureter.



Fig. 8 Microscopic picture taken from Figure 7 showing the papillary carcinomatous parts

contained different kinds of tissues. It was the case of a woman 68 years of age who had a small tumor which closed off the lower end of the left ureter and emanated from the ureteral wall. It was found to be composed of transitional epithelium, smooth muscle, and connective tissue that is of all the structural elements of the normal ureteral wall. It was therefore assumed by the author to be a hamartoma or hamartoblastoma. The time of origin would have to be placed in an early embryonic stage (70 millimeters long). One could not say, of course, how far the three principal components had increased in the course of their extra uterine existence or when they had commenced to proliferate.

Carcinosarcomata of the ureter have, as far as we are aware, not been reported up to the present. Such conditions in the urinary bladder have been described however for instance by Krompecher (1808), Leuenberger (1912), Kraft (1921), and Stenius (1925). The last mentioned author submits these tumors to a critical discussion.

For the diagnosis of a growth of carcinosarcoma, it is essential that a mixture of carcinoma and sarcoma should be established in one and the same tumor (Hertheimer). In stating this Hertheimer suggests three possibilities as to origin: (1) the carcinoma and sarcoma originate at the same time as a result of the same cause, (2) a carcinoma develops on account of an existing sarcoma, (3) in a carcinoma the stroma will develop into a sarcoma.



Fig. 9 Photomicrograph showing carcinosarcomatous tissue

Although the tumors belonging to the first group can be compared to real mixed tumors because they admit the assumption of a predisposition in their development, Hertheimer considers that they should be differentiated from the mixed tumors. It is quite clear that external irritation can cause the formation of the tumor, assuming either the presence or absence of predisposition. In this case the irritation must affect the epithelial elements and the connective tissue in producing the tumor formation. Fundamentally, it would be quite immaterial whether this affected both at the same time or to the same extent.

The second assumption of the genesis of the tumor has found the largest number of adherents because in most of the carcinosarcomata, the sarcomatous part preponderates. In connection with this and according to animal experiments it is quite doubtful whether the quantitative preponderance of one of the components speaks in favor of the sarcoma having appeared prior to the carcinoma. It is a well known fact that in these animal experiments (Apolant and others) it was proved that after repeated implantations of carcinosarcoma in white mice the sarcomatous part predominated, or as Hertheimer has put it so appropriately, was able to remain "the victor."

In connection with the third method of the formation of a tumor, it would have to be assumed that the carcinomatous cells were

capable of influencing the stroma toward a sarcomatous proliferation

We must now ask ourselves the question as to which of the three possibilities of the development of a carcinosarcoma, assumed by Herxheimer, might be applicable to the case described by us

We believe we are entitled to assume that in our case the formation of the tumor belongs to the first group. Having regard to the comprehensive capability of differentiation of the sarcomatous tissue, which leads to the formation of cartilage, it is probable that we have to deal with a young blastoma which has not yet matured and is therefore still furnished with a far reaching generative power. For the continuance of its existence, a predisposition, conditional to its development (sarcoma germ, retardation in development) might be made responsible.

The fact that there is no indication whatever for an inflammatory causation of the growth (concretion, papillomatosis) also appears to be in favor of a formation of the tumor, congenital in origin. Of course, we are unable to say what led eventually to the proliferation of the tumor in the locally predisposed portion of the ureter wall. The comparatively old age of this patient (71 years) does, in our opinion, not preclude the assumption that there might have been a local predisposition of tissue, reverting back as far as embryonic life. In Ku's case, the patient was 71 years and in Binder's case, 63 years of age.

We should not venture to decide whether the fairly advanced myxomatous component part of the carcinosarcoma, in our case, denotes the immature character of the particular site of the tumor or whether it should be taken as an expression of its degenerative change.

The proof of real mucus in these parts of the tumor, produced by thionine stain, might perhaps support the theory that we are dealing with real myxomatous tissue.

Finally, assuming a local predisposition already present in embryonic life, for the formation of the ureteral tumor, we should not omit to mention that we might have called our tumor a hamartoma, for, as already

mentioned, it showed, for no apparent reason, malignant proliferation of the germinal layers of which it was composed.

For information on the subject of scarcity of primary malignant ureteral tumors, we have prepared a statement of the cases of primary malignant neoplasm of the ureter, which were obtained from the postmortem department of the Pathological Institute of the University of Vienna, within a period of 5 years. From July 1, 1924, to June 30, 1929, there was a total of 13,854 autopsies. Among these were 3 cases of ureteral carcinoma and one case of ureteral myoma. In the latter, the still immature cells suggested a myosarcoma. This shows that primary carcinoma of the ureter is represented by 0.022 per cent and primary malignant neoplasma of the ureter in general, by 0.029 per cent of the post-mortem material. During the same time, there were altogether 31 cases of malignant tumor of the urinary passages, of which 24 affected the bladder and were all carcinomata, 3 affected the renal pelvis (2 papillomata and 1 pavement epithelium carcinoma) and, as already mentioned, 4 cases which primarily emanated from the ureter.

If we compare the number of the cases of primary carcinoma of the ureter, which we have found (i.e., 3) with the total number of carcinomata generally (2,124), which were observed during the 5 year period already mentioned, we see that carcinomata of the ureter are represented by 0.14 per cent of the carcinomata. Among the malignant tumors during this period (2,274) malignant ureteral tumors are represented by 0.18 per cent.

Before concluding this treatise, we should like to refer briefly to the pathology of the tumors of the ureter.

The classical symptom triad of tumors of the ureter, is, as we know, renal tumor, hæmaturia, and pain.

The enlargement of the kidney is the most frequent of these symptoms, any growth which narrows down the lumen of the ureter must lead to retention of urine above the obstruction, and finally to a condition of hydro-ureter and hydronephrosis.

Hæmaturia takes the second place in the symptom syndrome. According to Bachrach

it occurs in 45 per cent of all cases, while pain is said to be characteristic in about 33 per cent of the cases observed.

Where the ureteral tumor extends through the ostium into the bladder, the diagnosis, of course, is greatly facilitated by cystoscopy. This is confirmed in the series of Rousselot and Lamon, previously mentioned, in which only 4 cases out of 6 were correctly diagnosed when the tumor of the ureter had penetrated into the bladder.

It is evident that catheterization of the ureter contributes to the diagnosis of an obstructing tumor of the ureter. Ureterography is of a similar importance, but as yet, Bachrach gives these methods only scant praise.

The diagnosis of ureteral tumors was therefore rarely made in the past, and the reports were nearly always restricted to cases under postmortem examination. With increasing use of modern appliances for examination, the number of diagnosed cases rapidly accumulated.

In accordance with the previously mentioned compilation which includes 48 cases of ureteral carcinoma we see that the correct diagnosis was made in 15 and a tentative diagnosis in 2.

It will be seen also that the first case was diagnosed by Gerstein (1902), while between 1841 and 1922, the diagnosis of ureteral tumor in 32 cases, was made 5 times with certainty and once doubtfully. It was possible to make a diagnosis in the 16 remaining cases, beginning in 1923—in 10 cases with certainty and in 1 case with doubt.

From the description of our case, it is evident that the diagnosis was rendered especially difficult. Of the symptom triad, hematuria and renal tumor were present. The cystoscopic examination was a failure because the large tumor of the bladder obstructed every view. Catheterization of the ureter and also ureterography were prevented, as may be imagined, by the tumor of the bladder which was freely movable (compare Figs 1 A and B). In the suprapubic cystotomy operation which was subsequently carried out, a pedunculated and clearly defined tumor was removed from the bladder and

consequently there was no thought of a co existing tumor of the ureter. The enlargement of the right kidney was therefore thought to be due to another independent neoplasm, and the uræmia, which supervened after the operation, to the presence of a contracted kidney, which was thought to be pyelonephritic.

SUMMARY AND CONCLUSIONS

A carcinosarcoma of the right ureter is described. The tumor arose from approximately the middle of the posterior wall of the ureter. It filled practically the whole ureter as a sausage shaped formation, about the thickness of a finger. It penetrated into the urinary bladder and ended in a round swelling about the size of an apple.

The tumor of the ureter is considered a real carcinosarcoma and the local predisposition of the tissue already present in early embryonic stage, is assumed to have existed, thus causing the subsequent formation of the growth.

Of other malignant growths, about 50 ureteral carcinomata and about 10 tumors of the mesenchyme—most of them malignant growths—have, up to the present time, been described.

The opinion expressed by Israel, Glas, and Payer, that carcinomata of the discharging urinary passages could produce metastasis of the type of benign papillomata can not be shared in view of the examinations by Stoerk.

Malignant tumors of the ureter were found in the postmortem material of the Pathological Institute of the University of Vienna, to the extent of 0.029 per cent of the cases. In the total number of observed cases of carcinoma, those of the ureter represent 0.14 per cent, in the total of malignant tumors, 0.18 per cent.

The clinical diagnosis, tumor of the ureter, could not be made on account of the previously described conditions and especially in view of the fact that the hematuria and the X ray picture of the bladder could both be satisfactorily explained by the removal of a perfectly unencumbered, pedunculated, ball shaped tumor of the urinary bladder.

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THE IMPORTANCE OF ROENTGENOGRAPHIC EXAMINATIONS IN ACUTE CASES OF CIRCUMSCRIBED OR DIFFUSE PERITONITIS¹

ANDERS WISTENBORN, M.D. ULSALA SWEDEN

AS a rule no difficulties are encountered in diagnosing an acute peritonitis and the usual clinical methods of examination are sufficient to diagnose appendicular peritonitis. Occasionally, however, the symptoms are so obscure or unusual, that clinical examination fails to reveal sufficient facts on which to base an exact diagnosis. In such cases, therefore, further means of diagnosis would be of great use. This is especially true in small children and in cases in which the inflammatory process has not subsided after an operation but has caused the formation of intraperitoneal collections of pus. It is natural that in the past in such cases attempts should have been made to improve our methods of diagnosis by the use of the roentgen ray.

In general it is only during the past few years that the acute abdominal case has attracted more than superficial attention from the radiologist. Laurell was one of the first to make careful study of such cases, and he has reported a series of interesting observations. Reports of only very few cases in which roentgenographic examinations of appendicular peritonitis have been made appear in the literature. In 1927, Laurell and I described a case with multiple intraperitoneal abscesses after appendicitis, which were proved roentgenographically before they could be diagnosed clinically. By this method no less than five abscesses were discovered one after the other and, thanks to immediate incision, the patient was saved. Later, Lundberg and Lilja published reports of 3 cases of similar nature. So far as I am aware no other cases are reported in the medical literature.

In order to get a more detailed idea of the radiological appearances of acute peritonitis, a roentgenologic study was made at the University Hospital of Upsala of a large number of peritoneal cases, also those in which the clinical symptoms were perfectly clear. The observations of Laurell were of great help in

diagnosing obscure conditions. More than 100 cases have so far been examined by means of the roentgen ray. The results of our study will be published later by Laurell and the present writer so that here I will describe only a few of the earlier cases which are of particular interest from the clinical point of view.

METHODS OF ROENTGEN EXAMINATION

The abdomen and thorax are roentgenoscoped and roentgenograms are taken without the aid of contrast enema. In this way a quick examination can be made and the patient does not become unduly tired. If this means does not secure sufficient data and the condition of the patient warrants it, a barium enema is given, the roentgenograms then may reveal valuable data, particularly when an abscess presses against the colon.

The roentgenographic examination is generally carried out with the patient in the supine position, the respiratory movement of the diaphragm is tested, the lungs and pleural sacs are observed, shadows in the abdomen indicating possible exudation are examined and palpated with regard to tenderness to pressure, mobility, etc. Pictures of the abdomen and pelvis are taken with the patient lying on his back and with the rays applied in a vertical direction. When an ileus, a gaseous abscess, or free gas are suspected the respective parts of the abdomen are roentgenographed with the patient lying on his side, back, or, when it can be done, with the patient in a standing position. If the examination is made with the patient in varying positions it has been possible to form an idea also of the displacement of the exudate shadow.

Several conditions have been observed during the roentgen examinations indicating, more or less strongly, the existence of an inflammatory process in the abdomen. These conditions are

1. An appearance of a more or less pronounced ileus with increased gas and fluid

¹From the Surgical Clinic Professor Gunnar Nyström, M.D., Chief and the Radiological Department Hugo Laurell, M.D., Chief of the University Hospital, Upsala.

content and diminished motility of the intestines. Figure 1a shows levels as the rays were applied in a horizontal direction.

2 A rounded outline of the meteoristic small intestines with streaks or wedges of exudate between them, or between them and the abdominal wall (Fig 1b, c)

3 Fairly large homogeneous shadows in various parts of the abdomen in addition to those caused by the spleen and the urinary bladder. The small intestines, whether filled with fluid or empty, sometimes give homogeneous shadows closely resembling those of an exudate, when they are surrounded by gas filled small or large intestinal coils.

4 Circumscribed gaseous abscesses, e.g., in the right iliac fossa (Fig 1e)

5 Changes in the structure of the abdominal wall. On account of the inflammation, the various fatty layers and particularly the subperitoneal layer show an increased capacity for absorbing the X-rays, so that in this respect they resemble to a certain extent the surrounding tissues. Therefore the subperitoneal fatty layer becomes indistinct or even invisible, so that in the roentgenogram the abdominal wall appears more homogeneous, with blurred or vague contours, and with its interior outline more indistinct than normally (Fig 1f)

6 Changes in intestinal wall and lumen. It is possible to discover an abscess in the vicinity of the large intestine when X-ray examination is made of the colon with a barium enema. The abscess then makes an impression on, or causes a compression of, the intestinal lumen and the wall appears uneven, or jagged in outline. Sometimes the mucous membrane stands out in increased relief in the narrowed and sometimes spastically contracted parts of the colon (Fig 1g)

7 Diminished motility or paralysis of the diaphragmatic cupolus

8 Exudate in the sinus phrenicocostalis on one or both sides (Fig 1h)

9 Disappearance in the roentgenograms of the shadow of the psoas, or, in rare cases, when the inflammation has spread to the retroperitoneal tissues, an unusually distinct reproduction of the vessels in the subcutaneous fatty layer

Naturally, it is often impossible to diagnose an acute peritonitis solely by means of the roentgen-ray. Here as in other cases the anamnesis and the findings of the clinical and the roentgen examinations must all be taken into consideration and must amplify each other.

REPORT OF CASES AND DISCUSSION OF THE RESULT OF ROENTGEN EXAMINATION

In order to illustrate what has already been said and to show how useful to the surgeon roentgenographic examinations often are, a few of the cases treated in this clinic will be described briefly. The original negatives showed distinctly the roentgen findings but unfortunately some of the details do not show so clearly in the prints. First we present the histories of some adult patients with abscesses clearly visible in the roentgenograms.

CASE 1 No 2870/1028 Female, aged 18 years. When admitted to the hospital the patient had been ill for 3 days and showed evident symptoms of appendicitis. Temperature was 39 degrees C, pulse 115. Tenderness was noticeable over all the abdomen, particularly on the right side below the navel, where there were signs of a swelling.

Roentgenographic examination. In the right part of the true pelvis and in the right iliac fossa there was seen a homogeneous, or practically homogeneous, shadow indicating an exudate, and connected with the shadow of the bladder, which was emptied before the examination, and the shadow of the uterus (Fig 2). At operation an abscess was found near the right lateral wall of the pelvis. The abscess was filled with foul smelling pus and reached down to the bottom of the pelvis. No free exudate was present. The perforated appendix was removed and the abscess was drained.

CASE 2 No 2901/1928 Male, aged 35 years. Patient had been ill for 7 days with general abdominal disturbances. No certain diagnosis could be made clinically. The abdomen was soft, but not tender. Temperature was fluctuating. No palpable swelling was found.

The roentgenographic examination showed that the small intestines were meteoristically distended, further, a streak of exudate (1 to 2 centimeters wide) was visible along the right edge of the pelvis (Fig 3). The operation verified the roentgenographic findings. On the right, high up in the true pelvis, an appendicular abscess containing foul smelling pus was discovered.

In both of these cases the abscess has thus been diagnosed roentgenographically without the use of a barium enema. In the 2 following

cases such an enema had to be used in order to obtain pictures on which a certain diagnosis could be based

CASE 3 No 150/1929 Male, aged 18 years The patient had been ill for a week with clear symptoms of appendicitis When admitted his temperature was 40 degrees C Tenderness was present in the right part of the abdomen but there was no palpable abscess

Roentgenographic examination disclosed an increased amount of gas in the bowels The cæcum was displaced toward the left by a homogeneous soft shadow which partly covered the right iliac fossa and partly extended above it A barium enema was given which disclosed more clearly how the cæcum and the lower part of the ascending colon were displaced medially forward by a shadow from the soft parts about 10 centimeters in length and 5 centimeters wide This part of the colon showed an increased contractibility, and the relief picture of the mucous membrane was abnormally rich in folds (Fig 4) The lumbar spinal column showed a dextroconcave scoliosis and the outline of the psoas was invisible on the right side

At operation the abscess, the size of a hen's egg or bigger and situated behind the cæcum, was drained Convalescence was normal

CASE 4 No 2650/1927 This patient was a physician, 30 years old who was taken ill October 16 with abdominal pains rather diffuse but localized more to the left than to the right The pain resembled ordinary stomachache and was fairly in constant and not very intensive The patient himself and the colleague who attended him were both of the opinion that appendicitis was out of the question The temperature showed great fluctuations On October 18 it was 38.1 degrees C, on the 20th, 40.1 degrees and on the 22d, when the patient was admitted to the medical clinic, it was 37.9 degrees Diagnosis was uncertain also after examination in the medical clinic The palpation brought out no definite symptoms There was a certain degree of tenderness both deep down in the appendicular region and in the neighborhood of the left flexure The possibility of appendicitis could not be excluded, the patient was therefore roentgenographed (Oct 26)

Roentgenographic examination disclosed a distinctly increased amount of gas in the colon, the small intestines contained gas also but there were no fluid levels When an enema was given the colon filled up easily to the middle of the ascending part The proximal half of this filled only with difficulty and, when distended showed contractions which emptied it almost completely but which did not continue aborally This part of the intestine filled up and contracted time and again The cæcum was bent toward the medial line and together with the ascending colon it formed a sharp curve which enclosed an elliptical homogeneous shadow indicating an exudate Orally and medially, this shadow was

bordered by gas filled loops of small intestine The point of the cæcum was in such a position that it was very likely the shadow covered the point of the appendix The appendix did not seem to be filled with the enema The patient said he had the greatest tenderness just over this shadow (11g 5)

The patient was now transferred to the surgical clinic, and as the temperature showed an inclination to rise he was operated on The appendix was not found The abscess was drained It was found in the place disclosed by the roentgenograms and was the size of a walnut The patient died 3 to 4 weeks later from multiple abscesses in the liver Even at autopsy the appendix was difficult to locate It was perforated, and was situated medially and partly retrocæcally, and was surrounded by dense fibrous masses

In this case the diagnosis was almost exclusively based on the roentgenographic findings These were afterward confirmed by the findings at the operation and postmortem examination If the possibility of appendicitis had been suspected at an earlier stage, so that the patient could have been roentgenographed a few days earlier, a definite diagnosis would probably have been made then and the life of the patient might have been saved

In the 4 cases reported, *circumscribed abscesses* of appendicular origin occurred In 2 of these 4 cases a diagnosis was arrived at without a roentgenographic examination, whereas in the 2 others the abscess was detected only by means of the roentgen ray In the first 2 cases a distinct homogeneous shadow was visible in the small pelvis in the very place where the exudate was found In the 2 latter ones also, the shadow of the inflammation area could be distinguished in the roentgenogram (near the appendix) In order to strengthen the diagnosis of an abscess, a barium enema was administered The outline of the cæcal wall then appeared uneven and jagged in the neighborhood of the shadow mentioned and, further, an increased irritability was noticeable in the intestinal wall, thus indicating the existence here of an inflammation In all 4 cases the small intestines showed increased gas content but no signs of free exudate in the abdomen The operation verified the roentgenographic findings in every detail in all 4 cases

The 4 following cases show that the roentgenographic findings may be of great value also in cases of *diffuse peritonitis*

CASE 5 No 128/1928 A boy, aged 15 years. The patient had been ill for 2 days with diffuse abdominal pains, no vomiting but vesical tenesmus and macroscopically visible hematuria. When the patient was admitted the abdomen was distended and somewhat tense, with diffuse tenderness and a lot of blood in the urine. The roentgenographic examination confirmed the uncertain clinical diagnosis of peritonitis with the following findings. The small intestines were meteoristic with levels of fluid, a diffuse shadow was present in the right flank, the right iliac fossa, and the right side of the true pelvis, where some small gas bubbles were visible. In the left flank a few wedges of exudate were to be seen (Fig 6). At operation, diffuse and thick exudate was found in the abdomen and, in the right flank, a limited collection of pus reaching down into the true pelvis. It contained foul smelling pus and was due to a gangrenous appendix, which had burst. Patient was dismissed healed.

The clinical diagnosis was peritonitis of uncertain origin. The roentgenographic examination showed that there existed both a diffuse peritonitis and a more limited collection of exudate in the right part of the abdomen, probably from an appendicitis. This diagnosis was confirmed by the operation on every point.

CASE 6 No 585/1927 A girl, aged 2 years, was admitted to the pediatric clinic after having been ill for a few days with a cough and a feverish cold in the head, the last 24 hours before she was admitted she had vomited and suffered from diarrhoea. She was very weak, breathing was difficult, she ran a high fever, and her eyes were sunken. Many rales and rhonchi were noticed in her left lung. The abdomen was meteoristic and tender, but not particularly so, so that the doctor who attended her concluded that these abdominal symptoms might be due to changes in the lung. The following day the patient was worse. The lungs and abdomen were therefore roentgenographed.

Roentgenographic examination was made. Pneumonia could not be diagnosed with certainty. The diaphragm showed fairly good motility but was placed rather higher than usual on account of the meteorism of the bowels. In the flanks of the abdomen, especially on the right side, a homogeneous shadow was visible, indicating exudate and bordered medially by meteoristic small intestines. The true pelvis was completely filled by a homogeneous shadow (Fig 7). Roentgenographic diagnosis abdominal exudate. The operation showed a diffuse streptococcal peritonitis with a large amount of purulent fluid in the abdomen. The small intestines were filled with gas and flushed to a fairly strong red. The patient died the day after the operation.

In this case the tentative diagnosis was lung affection with peritoneal irritation until a roentgenographic examination was undertaken. This did not indicate any changes in

the lungs but brought out symptoms of real peritonitis.

As is well known, it is often very difficult with small children, sometimes even impossible, to decide if it is a case of real peritonitis or if the abdominal symptoms present are due to a peritoneal irritation, a peritonism, caused by a pulmonary affection. In these cases the roentgenographic examination is of the very greatest importance. In case of positive roentgenographic findings in the lungs, e.g., a central or beginning pneumonia, the peritonism may be explained and an operation may be avoided. On the other hand, a real peritonitis may occur also when lung symptoms are present, as in the case described above. In this last case the roentgen examination showed the supposed pneumonia to be out of the question and, further, it confirmed the uncertain clinical diagnosis of peritonitis.

In the 2 following cases of diffuse peritonitis we had the opportunity to follow the *post-operative development of the peritoneal exudate* by means of the roentgen-ray.

CASE 7 No 2811/1927 A girl, aged 8 years. Immediately on her admittance to the clinic November 1, the patient was operated on for diffuse streptococcal peritonitis and the abdomen was washed. After the operation the patient ran a high temperature, her general condition was low, and the abdomen was distended. A roentgenographic examination was made November 8, with the following findings. Exudate in the left flank, excessive exudate in the true pelvis, a mantling exudate in the left pleural cavity. The two diaphragmatic cupolas were dragging. The stomach, colon, and to a less extent the small intestines were meteoristic (Fig 8). Palpation per rectum showed a swelling in the fossa of Douglas. A large amount of pus escaped when the fornix vaginae was incised. Drainage tube was inserted.

November 11 the temperature was still high, and the abdomen was distended. Further roentgenographic examination showed that the abdominal exudate had increased in amount as had also the exudate shadow in the left flank. The drainage tube did not seem to drain the abscess in the pelvis, the reason being that it reached too high up and had no lateral holes at the level of the abscess (Fig 9). The right diaphragmatic cupola stood high, which made the presence of a subphrenic abscess probable. When the drainage tube was readjusted a large amount of pus escaped. After this a subphrenic abscess on the right was drained. Pus was found even in the right flank.

November 12 another roentgenographic examination was made. The exudate in the pelvis had

almost disappeared and the exudate in the left flank had shrunk in size, having apparently sunk into the true pelvis and being thus eliminated. The intestines were still meteoristic (Fig 10). The right diaphragm was high and paralyzed. Much exudate was noticed in the left pleural cavity. Patient died the following day. Postmortem examination was not permitted.

This case is of special interest. In the first place the roentgenographic symptoms of peritonitis were clear, and we could observe how the exudate collected in the typical places—the true pelvis, the flanks and the subdiaphragmatic cavities. Further, the roentgenographic examination showed that the drainage tube in the true pelvis did not function in the desired way because it ended too high up in the abdomen and had no lateral holes on a level with the abscess. When the tube had been adjusted in accordance with the roentgenographic indications the whole collection of exudate in the true pelvis disappeared and also the larger part of the exudate in the left flank, which latter must have been connected with the exudate in the pelvis.

CASE 8. No 1876/1928. The patient a girl, aged 7 years, was taken ill October 25 with abdominal pains and a mucous diarrhoea. The symptoms continued and when she was admitted to the clinic after having been ill for a week she was very weak, pale, dry and had sunken eyes. The temperature was 39.8 degrees C., and the pulse 132. The abdomen was distended, with diffuse tenderness. The diagnosis peritonitis of enteritic origin was clear.

Before the operation a short roentgenographic examination (October 31) was made, which showed increased contents of gas in the ventricle and the large and small intestines. The diaphragmatic cupolas showed little or no motility. Exudate was noticed in the flanks and the true pelvis (Fig 11). The subperitoneal fatty layer was not so distinct as usual. At operation a diffuse streptococcal peritonitis with strongly congested small intestines was found. A large amount of purulent fluid was found in the abdominal cavity, especially in the true pelvis. The abdominal cavity was washed and drained.

At first the patient was very ill, with a high temperature. The temperature went down slowly and the condition improved. The temperature rose on several occasions on this account a retention of pus was suspected and the patient was roentgenographed several times.

A roentgenologic examination November 21, 3 weeks after the operation, gave the following data: Moderate meteorism of the bowels. The two diaphragmatic cupolas dragged considerably. A small

bordering exudate was still to be found in the pleural sacs. The exudate in the pelvis had diminished in size. A further roentgenographic examination December 19 showed an indistinct semilunar shadow of gas under the left diaphragmatic cupola, on this account a colon enema was given. A large amount of barium escaped from the intestine into the cavity under the left diaphragmatic cupola (Fig 12a). Still signs of exudate remained in the left flank and in the true pelvis. A further roentgenographic examination about 2 months later showed that the hole in the intestine had closed as on this occasion no barium escaped (Fig 12b). A roentgenographic examination March 4 showed the true pelvis completely filled by the shadow of an exudate (Fig 13). By this time the exudate could be palpated. The abdomen was now re-examined and there was found in the true pelvis a large abscess and an abscess cavity under the left diaphragmatic cupola. Both these abscesses were connected with the operation wound by means of long fistulae. The abscesses were drained. Eventually the wounds healed and patient was discharged well.

This case resembles the previous one in many respects. It is a case of diffuse post-enteric peritonitis, which after the operation caused a series of circumscribed abscesses. Only part of the pus escaped directly through the surgical wound. The exudate in the left flank emptied itself spontaneously into the true pelvis, where 5 months after the operation a big abscess was formed, while the flank exudate disappeared. Of greatest interest in this connection is the subphrenic abscess. At the roentgenographic examination December 19, a large amount of contrast mass penetrated from the left colonic flexure up into a big subphrenic abscess cavity. This had apparently been formed at an earlier stage, perforated into the colon, and to a large extent had emptied itself. The drainage into the colon had not been complete, however, and part of the pus found its way to the surgical wound in the right iliac fossa. The long fistula clearly shows this. Neither the flank exudate nor the subphrenic abscess could be diagnosed clinically and were proved only by means of the roentgen ray. This case of subphrenic abscess, which was diagnosed by means of a barium enema, is probably the first of its kind to be published.

The last 4 cases were of diffuse peritonitis which is easily diagnosed with the roentgen ray. The clinical diagnosis of peritonitis did

not cause any difficulty in 3 of the cases—in one only was it difficult to make a differential diagnosis. In these as in the first 4 cases the roentgenographic symptoms were increased gas content in the intestines and homogeneous shadows of exudate between the meteoristic intestines on the one hand and on the other the walls of the abdomen or the pelvis. Such exudate shadows were visible in several places, as for instance in the true pelvis and the flanks, and under the diaphragmatic cupolas. From the flanks they penetrated between the small intestines in the form of streaks or wedges, as a result of this the outlines of the small intestines were more rounded than usual. Further symptoms in these cases have been pleural exudate, diminished motility of the diaphragm and, in 2 cases, a somewhat more blurred than normal appearance of the abdominal wall in the flank. In Case 5 there also appeared a few small gas bubbles in a circumscribed exudate shadow in the right flank. It is difficult to decide if such gas bubbles are located in the intestinal lumen or outside it in the abdominal cavity. Here one must have recourse to palpation, and the patient must be examined in different positions and with the rays at different angles. Intestinal gas is generally easily displaced while the gas bubbles in a circumscribed abscess remain in about the same place.

These last cases illustrate the fact that the roentgenographic examination brings out points of decisive importance in the diagnosis of peritonitis and, still further, that by repeated roentgenographic examinations after the operation it is possible to follow the development of the peritonitis, fatally or favorably, more closely than can be done by clinical examinations only. Sometimes a collection of exudate can be detected earlier by means of the roentgen-ray than by a clinical examination in this way it may be possible to make a new incision at an earlier stage than could have been done otherwise.

It is a well known fact that in cases which have been operated on more or less recently it is very difficult to get an exact idea of the abdominal conditions by means of a clinical examination only, as the results of a palpation are bound to be uncertain on account of the

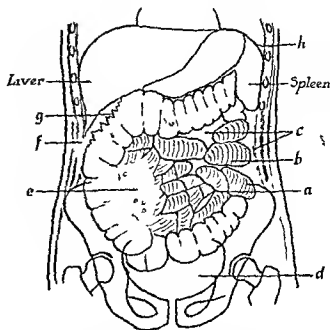


Fig. 1. Skeleton roentgenogram showing *a*, meteoristically distended small intestines, *b*, rounded outline of the intestines, *c*, wedges of exudate between the intestines and exudate in the flanks, *d*, exudate in the pelvis, *e*, gaseous abscess, *f*, non visibility of the fatty layer of the abdominal wall, *g*, jagged outline of the wall of the colon, *h*, exudate in the sinus phrenicocostalis.

surgical wound and the ensuing pain. The more or less pronounced intestinal meteorism which is very common in these cases makes it still more difficult to judge of the real abdominal status. The following cases illustrate the value of the roentgen-ray in these clinically obscure cases.

CASE 9. No. 242/1929. A girl, aged 16 years, was operated on for diffuse appendicular peritonitis. About a fortnight after the operation an intraperitoneal collection of pus was suspected on account of the fever and the somewhat distended abdomen with a slight diffuse tenderness. No abscess was palpable, however. The roentgenographic examination showed a diffuse shadow covering the whole area of the true pelvis, and the diagnosis was pelvic abscess (Fig. 14). Not until a week later did this abscess in the true pelvis become definitely palpable. A renewed roentgenographic examination showed that the shadow of the exudate had by now decreased in size but that it had become more dense (Fig. 15). An incision was made and a considerable amount of pus escaped. The roentgenographic examination made a few days later showed that the shadow had disappeared.

In all probability the big pelvic shadow in the first roentgenogram was due chiefly to a small abscess with oedema around it and free



Fig 2

Fig 2 Case 1 Abscess shadow in the true pelvis (indicated by the arrows)



Fig 3

Fig 3 Case 2 Abscess shadow in the true pelvis



Fig 4

Fig 4 Case 3 Abscess shadow a Spastic contraction of the ascending colon

exudate in the pelvis. At the time of the second examination the edema and the free exudate had decreased while the abscess had grown, so that the shadow visible in the roentgenogram had become smaller but more dense and the abscess palpable.

In the following case also it was possible to prove the existence of a pelvic abscess by means of the roentgen ray several days before it was clinically palpable.

CASE 10 No 3511/1927 Woman aged 30 years had been operated on for a diffuse appendicular peritonitis and for several weeks after the operation she ran a higher temperature than could be explained by the presence of a thrombosis. The abdomen was soft and no abscess was palpable but the leucocyte count was comparatively high (18 200). The roentgenograms taken 25 days after the operation showed a homogeneous shadow to the left in the pelvis, probably due to an exudate and increased contents of gas in the bowels (Fig 16). Not until about 2 weeks later was it possible to palpate the abscess. A roentgenographic examination showed that by this time the shadow of the exudate had become larger and more dense. Three days later the abscess was easily felt and it was incised.

The following case is of particular interest because the roentgenographic examination points to a totally different diagnosis than the clinical one.

CASE 11 No 2676/1928 A girl, aged 6 years was operated on in November 1927, for appendicular abscess the appendix was removed and the abscess drained. The patient was discharged well. During the following year she often complained of abdominal pains. About a year after the first

operation she was again admitted to the hospital having been taken ill with abdominal trouble resembling ordinary colic vomiting and fever up to 39 degrees C. When she was admitted to the hospital the abdomen was soft with no palpable swelling. The temperature remained at 38 to 39 degrees while the abdomen grew bigger and ascites was suspected, therefore a diagnosis of tuberculous peritonitis was made. In order to confirm this diagnosis the abdomen was roentgenographed. No free fluid was present in the abdomen. A circumscribed collection of exudate in the true pelvis was noted. The bowels were meteorologically distended (Fig 17). The diagnosis of postappendicular abscess seemed probable. A week later the abscess became palpable. At the operation, the incision being made above the symphysis an abscess nearly the size of a goose's egg and filled with foul smelling pus was discovered in the superior strait of the pelvis. The patient was discharged well a month later.

In the 3 last cases it has been possible to prove roentgenographically the existence of an abscess in the pelvis 1 or 2 weeks before it could be diagnosed by palpation. In such cases it is generally a question of abscesses high up in the pelvis, which are difficult to palpate on account of their position, and certain recent limp abscesses which are soft and yielding to the touch. However, intraperitoneal collections of pus in other places may also be discovered by means of the roentgen ray. This is proved by the following interesting case which had a very unusual course after operation.

CASE 12 No 2144/1928 A girl, aged 16 years was operated on August 11 for acute gangrenous appendicitis without peritonitis. The abdomen was

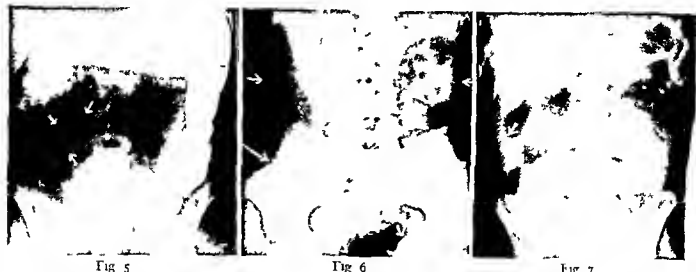


Fig 5

Fig 6

Fig 7

Fig 5 Case 4 Abscess shadow in the right loin Spastic contraction of the ascending colon

Fig 6 Case 5 The small arrows mark the exudate shadows The bigger arrow indicates small gas bubbles in the right iliac fossa Distended intestines

Fig 7 Case 6 Meteoristic intestines Exudate in the flanks and the true pelvis (the late exudate only partly visible on the figure)

closed without drainage. Four days after the operation the patient had a chill and her temperature was 40 degrees C. The throat was flushed. No subjective abdominal symptoms and only such tenderness as might be expected on account of the surgical wound were noticeable.

Roentgenographic examination was undertaken mostly to exclude the possibility of abdominal trouble. On the right in the true pelvis was found a shadow indicating exudate and communicating with another shadow in front of the promontory. The outline of the right psoas was invisible (Fig 18), and so was the fatty layer of the abdominal wall in the right flank. The diaphragmatic cupolas showed decreased motility. The leucocytes count was 12,400. The following day an operation was done based upon the roentgenographic findings combined with the clinical appearance, the constant fever, and an increasing tenderness. Retrocaecally, paracaecally, and infracaeally was discovered an abscess filled with colon bacillus smelling pus, it was drained. Three weeks later the temperature rose again. The wound in the abdomen was by now practically healed. No palpable swelling was present. Roentgenographic examination discovered an abscess between the lateral abdominal wall and the ascending colon, the liver, and the right kidney. On the lower side it was bordered by the bent apex of the caecum and a coil of the small intestine (Fig 19). The subperitoneal fatty layer was infiltrated where the abscess pressed against the lateral abdominal wall. The part of the colon next to the abscess was meteoristic and showed a peculiar denticulated outline. The gas content of the intestines hardly increased. The right diaphragmatic cupola dragged a little. The operation revealed an abscess the size of a hen's egg in the place indicated and pressing against the ascending colon. The patient was discharged well

September 9, but was admitted again with another abscess in the same place. This time the abscess was palpable clinically and an excellent roentgenogram of it was obtained. The abscess was drained and soon healed, the patient has been quite well since.

It is, of course, very unusual to find an *intrapitoneal abscess after an appendicitis* of the kind which permits a primary suture, and it is still more remarkable to find no less than three abscesses one after the other, as in this case. It is probable that the cause was a rupture of the appendix ligature and a small leak in the remaining stump of the appendix. At different times faecal matter was found in the dressing of the wound. The first two abscesses could be diagnosed roentgenographically before there were any definite clinical symptoms.

Naturally, the fact that the shadow of an abdominal abscess was visible in the roentgenograms after an operation for peritonitis does not always mean that an incision must be made and the abscess drained. The abscess contents may be absorbed or may be spontaneously emptied through a drainage canal in the vicinity. What course to take after the discovery of such a shadow of an abscess must be decided in each separate case according to the clinical appearances and development. In this clinic we have had several cases in which such a shadow has



Fig 8



Fig 9



Fig 10

Fig 8 Case 7 Distended bowels Shadow from an exudate in the true pelvis Streaks of exudate in both flanks (chiefly in the left one)

Fig 9 Same case as in Figure 8 The pelvic abscess

has increased in size The rubber tube does not drain the abscess

Fig 10 Case 7 The pelvic exudate has now disappeared (cf Fig 9)

been visible in the roentgenogram but has disappeared again after some time without any operation being necessary

In other forms of peritonitis as well, e.g., in tuberculous peritonitis, the roentgenographic examination may yield valuable decisive factors in arriving at the diagnosis. Such cases are not treated in the present paper, but the reader is referred to the various works by Laurell on the roentgenology of acute abdominal conditions

It is obvious that in reading the roentgenograms there are various possible *sources of error* to take into consideration. Above all it must be remembered that the shadows of the urinary bladder vary in density with the degree of its distention and that when only moderately filled and unevenly rounded, the bladder will sometimes give pictures which resemble those of a pelvic exudate. Before the roentgenographic examination is begun the bladder must therefore be emptied, and if the patient cannot empty it completely by himself this must be done by catheterization, and a picture taken afterward. Further, the picture of the small intestines filled with fluid or of an agglomerated omentum often

resembles the shadows of an exudate, this is also the case with a mass of empty small intestines surrounded by meteoristic parts of the colon. In order to avoid these and similar stumbling blocks it is necessary, in dubious cases to take pictures of the patient in various positions and to compare all the roentgenographic findings. If one suspects that a certain shadow indicates an exudate, other special signs of abdominal inflammation should be sought for, as for instance spasticity, state of the intestine, paralysis of the diaphragm, exudate in the sinus phrenicocostalis, or the invisibility of the fatty layers in the abdominal wall, etc., all these radiological symptoms must be compared with the anamnesis and the clinical findings

By means of these roentgenographic signs typical of an inflammation it is also possible to distinguish between an exudate and other collections of fluid in the abdomen, e.g., intraperitoneal hemorrhage. It must be remembered, however, that a small pleural exudate can be found also in cases of hemorrhage in the upper part of the abdomen

The roentgenographic examination itself is very simple, as is evident from what has



Fig 11

Fig 11 Case 8 Distended bowels Exudate in the pelvis and the flanks (chiefly in the right one)

Fig 12 Case 8 A, Subphrenic abscess filled with barium from a colon enema B, Two months later The



a Fig 12 b

fistula of the colon is healed No barium is to be seen under the diaphragmatic cupolas

Fig 13 Case 8 True pelvis entirely filled by a homogeneous shadow from an abscess



Fig 13



Fig 14

Fig 14 Case 9 Big shadow of an abscess in the pelvis

Fig 15 Same case as Figure 14 X-rayed a week later The shadow of the exudate is smaller but denser



Fig 15



Fig 16

Fig 16 Case 10 a Abscess shadow to the right in the true pelvis

already been said It need not tire the patient, it can be carried out without much loss of time, e g, while the operating room is made ready for the operation The interpretation of the roentgenograms is sometimes rather difficult, it is true, but in many cases the plates can be read by any medical man with a little training even if he has not specialized in roentgenology

It is quite possible that in some of the cases described the roentgenographic examination has saved the life of the patient At all events, many of the patients have been operated on at a considerably earlier stage, thanks to such examination, than would have

been possible otherwise In a case of peritonitis this is naturally of the greatest importance Further, in dubious cases especially when it is necessary to avoid an operation if possible, e g, in small children or in very old persons, it is very valuable for the operator to be able to confirm his diagnosis before the operation by means of roentgen examination or to exclude peritonitis on the strength of negative roentgenographic findings The last consideration is a point of the utmost importance It often happens that laparotomy is done because the possibility of peritonitis cannot be excluded solely on the strength of the clinical findings, but opera-



Fig. 17



Fig. 18

Fig. 17. Case 11. Meteoric bowels. Much crowded in the pelvis.

Fig. 18. Case 12. *a* Abscess in the right flank with impression and jagged contour of the colon wall.



Fig. 19

Fig. 19. Case 12. *a* Abscess in the right flank with jagged contour of the colon wall. *b* Some weeks later. The abscess has disappeared and the wall of the colon is normal.

tions fail to disclose peritonitis. Clinical symptoms resembling those of peritonitis may arise from many causes beginning pleural effusion, cardiac insufficiency, or an irritation of the peritoneum from the retroperitoneal organs, etc. An exploratory laparotomy may greatly complicate the prognosis in these cases. By the more extensive use of roentgen examination it will, of course, be possible to make definite the diagnosis in more cases of peritonitis, and this will mean that the number of cases on which laparotomy is done on an uncertain diagnosis and at operation proved to be negative for peritonitis will considerably decrease. Thus at the University Hospital of Upsala we have already profited by using the roentgen examination for thanks to negative roentgenographic findings in several cases with regard to peritonitis no operation was done.

It is my opinion that the use of roentgen ray in examining patients with acute abdominal conditions will prove of the greatest importance in the near future in making diagnosis as to free and circumscribed acute peritonitis.

SUMMARY

In order to investigate the roentgenologic picture of acute peritonitis, a large number of peritoneal cases have been radiographed in the University Hospital of Upsala. Changes quite characteristic of acute peritonitis were

found. The author describes the technique used, interprets the roentgenograms, and tells of the most important causes of error in studying the pictures. He reports some cases in which the radiological examination has given valuable information in the diagnosis of acute diffuse or localized peritonitis. The method has been of especial value in confirming doubtful clinical diagnoses in small children and as a means of discovering post operative intraperitoneal abscesses. In several cases such abscesses have been precisely located much earlier through roentgenographic study than would have been possible through clinical examination only.

The present paper is based on a lecture delivered at the meeting of the Surgical Association of Sweden in Stockholm, November 1928 and at the Congress of the Surgical Association of Germany in Berlin, April 1929.

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"LYMPHOSARCOMA" OF THE NECK¹

JOHN W. SPIES, M.D., NEW HAVEN, CONNECTICUT

The Department of Surgery Yale University School of Medicine

THE object of this study is (1) to call attention to the existence of certain types of carcinomata which may be readily confused with the so called "lymphosarcomata" of the cervical lymph nodes, and (2) to emphasize the need of a clinicopathological analysis of a larger number of cases than can ordinarily be produced by one institution, thus the necessity for sending all available material to the Lymphoid Tumor Registry, Army Medical Museum, Washington, D. C.

No cases known to be still living were included in the present series. In order to secure uniformity a further restriction was made in that each case must have had a definite histological diagnosis from the department of pathology of the Memorial Hospital. Pathologists vary in their ability and criteria. Therefore, outside diagnoses have not been accepted. This narrow, arbitrary selection of material seems justified because of the difficulties in diagnosis which every pathologist (no matter who he is) apparently encounters in the lymphoid group of tumors. Indeed, it may be exceedingly hard to differentiate an inflammatory process from a neoplastic one. Typical features may be readily detected, but atypical tissue responses may "plague the soul" of the most competent microscopist, and oftentimes he may not be able to render a clear cut decision. Consequently, the author hopes that he will not be misunderstood when he casts aside diagnoses which he has had no opportunity of checking or which have been made by persons with whose qualifications he is unacquainted. Only 50 cases were found which met these requirements. After a careful re-study of the histological structure of these 50 cases the following tentative classification was employed.

No classification of lymphoid tumors is wholly satisfactory. Until the etiology is discovered, the histogenetic one employed by Ewing (4) is the most logical. On account of the disappointing state of affairs everybody

interested in this group of neoplasms should send specimens and data to the Lymphoid Tumor Registry, Army Medical Museum, Washington, D. C., so that ultimately a large collection will be available for study. This will stimulate interest and may somewhat relieve the chaos of today, even though future experimental studies should happily produce an etiological classification.

In the past the supposed futility of subdividing the lymphoid tumors was evidently recognized by Mallory. He employed the term lymphoblastoma, to include lymphocytoma, lymphoma, lymphosarcoma, pseudoleukemia, lymphatic leukemia, and Hodgkin's disease. He defined a lymphoblastoma as being "a tumor of mesenchymal origin of which the cells tend to differentiate into lymphocytes, that is, into cells of the lymphocyte series." This general point of view may have been perfectly justified and may continue to be so until the accuracy and value of subdivision is established. This may be hoped for by the application of ideas gained in the analysis of a small series only if such conceptions can furnish clues for the study of large amounts of material with the accompanying data. For this latter we need a tumor registry.

The series upon which this study is based does not contain a sufficient number of cases to be of great statistical importance. *The classification employed is not recommended for lymphoid tumors.* It merely affords a convenient way to study a group of tumors that have been classified in the hospital files as lymphosarcoma of the neck.

A few explanations will be given concerning the grouping used in this study. The reticulum and the lymphocytic cell of the lymph gland may conceivably give rise to a separate neoplastic process. In some cases this distinction seems well preserved and readily detected. In others one may apparently be confronted with both types of cells participating in the new-growth. Even though Hodgkin's disease is improbable, one may occasionally,

¹ From the Department of Pathology of Cornell University Medical College and the Memorial Hospital, New York.



Fig 1



Fig 2

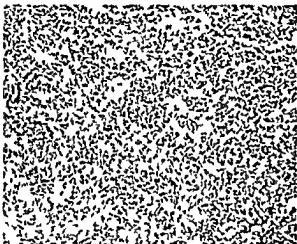


Fig 3

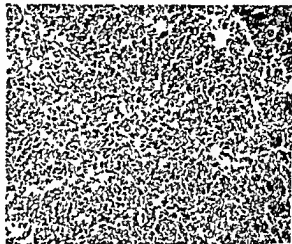


Fig 4

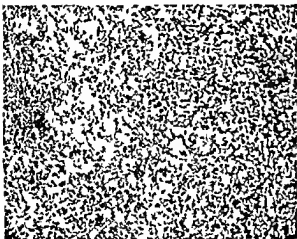


Fig 5



Fig 6

(Legend on opposite page)

TABLE I—CLASSIFICATION

| | Cases | Percentage |
|----------------------------------|-------|------------|
| Lymphosarcoma | 33 | 66 |
| Reticulum cell type | 21 | 42 |
| Lymphocyte cell type | 2 | 4 |
| Atypical cell type | 10 | 20 |
| Lymphogranuloma | 5 | 10 |
| Chronic non specific | 4 | 8 |
| Probable Hodgkin's | 1 | 2 |
| Carcinoma | 5 | 10 |
| Transitional cell | 2 | 4 |
| Lympho epithelioma | 3 | 6 |
| Unclassified | | |
| Slides not available for restudy | 7 | 14 |
| Total | 50 | 100 |

see large multinucleated cells. When one has these admixtures, there is added an "atypical" feature to what is otherwise a straightforward case of lymphosarcoma. Also, inflammatory reactions of various types and degrees may force one to attach the label of "atypical."

The true neoplasms (arising from easily identified parent cells and uncomplicated by extraneous elements) present an easier histological diagnostic problem than do those processes which exhibit some of the features of chronic inflammation. In this latter group

Fig 1 Lympho epithelioma. Large well defined groups of cells present an epithelioid arrangement. Lying within the dense fibrous stroma are other cells of the same character but which are more loosely disposed and which carry a sparse admixture of lymphocytes.

Fig 2 Transitional cell epidermoid carcinoma. The nuclei are dark. Syncytial masses are absent. There are no accompanying lymphocytes. The cells are not densely packed. The vessels in the upper and lower part of the figure contain coagulated blood and not tumor cells.

Fig 3 Reticulum cell lymphosarcoma. Most of the cells resemble the reticulum cells seen in lymph nodes. They vary in shape and size but are sufficiently typical to warrant the diagnosis. Lymphocytes are infrequent and do not appear to be participating in the tumor process.

Fig 4 Lymphocytic cell lymphosarcoma. These cells cannot be differentiated histologically from lymphocytes. The morphology combined with the features of unrestrained growth give the diagnosis.

Fig 5 Chronic lymphogranuloma. In addition to cells of neoplastic character, there are lymphocytes, plasma cells, large endothelial leucocytes, somewhat amorphous connective tissue, and a few polymorphonuclear neutrophilic leucocytes.

Fig 6 Atypical lymphosarcoma. There is dense, abundant fibrous tissue, suggesting invasion of extraneous tissue rather than a supporting stroma. The tumor cells lie within this and in some places line large tissue spaces. They are often of giant size and possess several nuclei. There is no clue as to their origin. Lymphocytes are few. There are no definite polymorphonuclear leucocytes. One is unable to classify this process.

belong the malignant lymphogranulomata. These have the power of unrestrained growth associated with the picture of chronic inflammation. Perhaps the best known of these is Hodgkin's disease. Even this interesting form (which has long been suspected of being some atypical reaction to tuberculosis) is often very difficult to diagnose. Most other malignant lymphogranulomata have evaded all efforts to subdivide them satisfactorily on a histological basis.

In this study the term "lymphogranuloma" is used to designate tumors which may present any, or all, of the following features: fibrosis, plasma cells, eosinophiles, and mononuclear cells of various types but which do not present the typical picture of Hodgkin's disease or of "lymphosarcoma." Four of these were found. Another was sufficiently typical of Hodgkin's disease to place it in a separate group.

CARCINOMA SIMULATING LYMPHOID TUMORS

In 1921, Schmincke, also Regnaud, Reverchon and Coutard, drew attention to malignant tumors occurring in the nasopharynx, region of the tonsil, and the base of the tongue, in which the histology suggested that of an anaplastic carcinoma associated with an abundance of lymphocytes. The term "lympho-epithelioma" was applied. In 1922, New described a syndrome in which 51 of 79 cases of malignant tumors of the nasopharynx presented cervical lymphadenomegaly as the first clinical evidence of the disease. In 18 of the 51 patients the discovery of the primary nasopharyngeal tumor was not made until after the operation upon the lymph nodes of the neck. In this group of 79 cases there were 34 carcinomata, 33 lymphosarcomata, 7 in which the type was undetermined, and 5 had no histological examination. In 1925, and again in 1927, Quick and Cutler produced evidence to show that about 10 per cent of the intra oral carcinomata are very radiosensitive and that often the first manifestation of the disease is the enlargement of the cervical lymph nodes. Their sections appeared to be those coming from very anaplastic epidermoid carcinomata, and the association of lymphocytes was slight or absent. These last authors called attention to the likelihood of distant internal metastases,

whereas in squamous carcinoma arising from the same sites it is unusual to find visceral deposits. Jovin reported the occurrence of distant metastases to the bones and internal viscera. In 1929, Ewing reviewed the subject of lympho epithelioma, and concluded that the "exact scope is not yet clear." He stated that the diagnosis must be made on structure rather than on clinical data. His study of a group (200 cases) of tumors of the base of the tongue and the tonsil revealed that 72 per cent were squamous carcinoma, 12 per cent were of the transitional cell type of epidermoid carcinoma, 9 per cent were lympho sarcomata, 4 per cent were lympho epitheliomata, and 3 per cent could not be classified. In a collection of nasopharyngeal neoplasms (100 cases), the same author found that squamous carcinoma accounted for 30 per cent, 37 per cent were transitional cell epidermoid carcinomata, 15 per cent were lympho sarcomata, 11 per cent were lympho epitheliomata, 3 per cent were malignant adenomata, and 4 per cent were adenoid cystic epitheliomata. In 1923, Crowe and Baylor were of the opinion that it was sometimes impossible to differentiate histologically between sarcoma and carcinoma and that a sufficient accumulation of clinical data was valuable. They listed 16 cases as carcinomata, 26 as sarcomata, 5 as angiosarcomata, 3 as myxosarcomata, 10 as lymphosarcomata, and 8 as angiomas. This would make a total of 68 cases and give approximately 23 per cent for carcinomata and 14 per cent for lymphosarcomata. If one eliminates the 8 cases of angiomas, leaving only malignant tumors, one arrives at about 27 per cent for carcinomata and 16 per cent for the lymphosarcomata. One may compare these figures with Ewing's 48 per cent for epidermoid carcinomata and 15 per cent for lympho sarcomata, also, with New's about 42 per cent for carcinomata of all types and about 44 per cent for lymphosarcomata. In 1929, Cutler made a careful study and drew the conclusion that although transitional cell epidermoid carcinomata and lympho epitheliomata were separate histological entities, they might not be so differentiated clinically. He also stated that in some cases these epithelial tumors might be confused with lymphosarcomata,

both histologically and clinically. The lymphoid tumors exhibited a shorter course, gave earlier constitutional symptoms, and more often produced bilateral cervical lymphadenomegaly, especially in the first stage of the disease. He believed that the treatment is the same for lymphosarcomata as for carcinomata of a radiosensitive type. From this he reasoned that the separation from a practical standpoint is not very important.

The articles already referred to are cited in order to substantiate the claim that there are several varieties of malignant neoplasms which exhibit themselves mainly in the cervical lymph nodes and that within these there is a well recognized group of carcinomata which may be readily confused both histologically and clinically, with certain types of lymphoid tumors. A restudy of the data and material now available in hospital files may reveal, as it has in this study, that carcinomata constitute an appreciable percentage of the cases filed under "lymphoid tumors."

The 7 cases listed under the heading of "unclassified" are those in which a biopsy was taken outside of the General Memorial Hospital but which unfortunately had to be returned to the sender. Thus the diagnosis was confirmed, but the slides are not now available for restudy. All attempts to secure them have failed. From Table I, one may assume that these 7 cases might contain tumors of a different histological structure even though they have been passed as lympho sarcomata. Some might even be carcinomata.

With these explanations in mind and with the restatement that *the present writer is not presenting a tumor classification* but is attempting to separate certain histological types discovered within the hospital files as lympho sarcoma of the neck, the reader's attention is invited to Table I. This reveals that the lymphosarcomata constitute 66 per cent, the lymphogranulomata, 10 per cent, the carcinomata, 10 per cent, and the unclassified (because of no slides available for restudy), 14 per cent. Within the lymphosarcomata the reticulum cell type accounts for 42 per cent, the lymphocyte cell type, 4 per cent, and the atypical cell type, 20 per cent. As an interesting coincidence the carcinomata form 10 per

TABLE II—AVERAGE AGE ON ADMISSION TO THE HOSPITAL

| | Years |
|------------------------------|-------|
| Reticulum cell lymphosarcoma | 44 |
| Atypical cell lymphosarcoma | 38 |
| Chronic lymphogranuloma | 53 |
| Average | 45 |

TABLE III—AGE BY DECADES—PERCENTAGE

| | 2 | 3 | 4 | 5 | 6 | 7 |
|------------------------------|----|----|----|----|----|----|
| Reticulum cell lymphosarcoma | 14 | 14 | 14 | 14 | 20 | 24 |
| Atypical cell lymphosarcoma | 10 | 30 | 10 | 20 | 30 | |
| Chronic lymphogranuloma | | | | 50 | 25 | 25 |
| Average percentage | 8 | 15 | 8 | 28 | 25 | 16 |

cent of the entire group. This is the figure that Quick and Cutler gave as to the relative frequency of transitional cell epidermoid carcinoma among intra-oral carcinomata as a whole. One notes, too, that in New's analysis of malignant tumors of the nasopharynx 11 per cent were of an undetermined type. The one case of probable Hodgkin's disease had metastases to the spinal column as shown roentgenologically and clinically.

CLINICOPATHOLOGICAL ANALYSIS

Although it is realized that the cases are too few in number to assume any statistical importance, it is hoped that a few interesting points may be elicited. But among the lymphoid tumors only the reticulum cell type, the atypical cell type, and the chronic granulomata comprise a sufficient number to justify such an attempt. The carcinomata may be best studied in the references mentioned.

In a recent paper Elkin has reported his study on 41 primary neoplasms of the lymph nodes. He considered 15 of these to be lymphosarcomata and gave the average age of his patients as 33 years. The average age of Cutler's series of 9 epidermoid carcinoma cases was about 51 years. In Table II, the average is 45 years. The reticulum cell group lies between the 2 other groups, having 44 years for its average.

The lymphogranulomata occurred in this series at a distinctly later age than did the lymphosarcomata.

No granulomata occurred in males. In the sarcomata the females were in the minority.

TABLE IV—SEX—PERCENTAGE

| | Males | Females |
|------------------------------|-------|---------|
| Reticulum cell lymphosarcoma | 57 | 43 |
| Atypical cell lymphosarcoma | 60 | 40 |
| Chronic lymphogranuloma | — | 100 |
| Average percentage | 39 | 61 |

TABLE V—SIDE OF NECK IN WHICH THERE WERE NODES—PERCENTAGE

| | Right | Left | Both | Not stated |
|------------------------------|-------|------|------|------------|
| Reticulum cell lymphosarcoma | 14 | 14 | 48 | 24 |
| Atypical cell lymphosarcoma | 20 | 20 | 50 | 10 |
| Chronic lymphogranuloma | 25 | — | 75 | — |
| Average percentage | 20 | 11 | 58 | 11 |

TABLE VI—EXTERNAL SITES—IN RELATION TO THE NECK—PERCENTAGE

| | Above | Below | Neck alone | Above and below |
|------------------------------|-------|-------|------------|-----------------|
| Reticulum cell lymphosarcoma | 38 | 10 | 19 | 33 |
| Atypical cell lymphosarcoma | 20 | 20 | — | 60 |
| Chronic lymphogranuloma | 25 | — | — | 75 |
| Average percentage | 28 | 10 | 6 | 56 |

In the granulomata the left side alone was not involved. In all three types bilateral involvement was the rule. It would seem that the involvement of both sides of the neck is more frequent in the lymphoid tumors than in the transitional cell epidermoid carcinomata, although it is well known that it may occur in the latter.

The term "external sites" in Table VI is employed in the sense of including all superficial regions and in addition the mouth, nose, and pharynx. The term does not include the internal viscera. It is to be remembered that all cases in this series had involvement of the cervical lymph nodes.

None of the granulomata were found to be confined to the neck alone. Seventy-five per cent of them had lesions both below and above the neck. Likewise the atypical lymphosarcomata were never found in the neck alone, and the majority were both below and above the neck. If one compares the findings in Table VI with the duration of symptoms (Table VII), one is struck with the fact that the duration of life varies directly with the amount of external involvement. This suggests that the amount of external involvement varies directly with the amount of internal

TABLE VII—DURATION OF SYMPTOMS IN RELATION TO MEMORIAL HOSPITAL ADMISSION

| | Months before | Months after | Total |
|------------------------------|---------------|--------------|-------|
| Reticulum cell lymphosarcoma | 8 | 13 | 21 |
| Atypical cell lymphosarcoma | 8 | 9 | 16 |
| Chronic lymphogranuloma | 4 | 7 | 11 |
| Average | 7 | 9 | 16 |

TABLE VIII—GENERAL CONDITION UPON HOSPITAL ADMISSION—PERCENTAGE

| | Poor | Fair | Good | Not stated |
|------------------------------|------|------|------|------------|
| Reticulum cell lymphosarcoma | 24 | 10 | 66 | |
| Atypical cell lymphosarcoma | 30 | 10 | 50 | 10 |
| Chronic lymphogranuloma | 100 | — | — | — |
| Average | 51 | 7 | 39 | 3 |

visceral involvement. This can be determined only by a large autopsy series. Minot and Isaacs (8) state that "data at hand suggest that if abnormal sized nodes are searched for they will be found in cases with lymphoblastoma, particularly involving internal structures more often than is suggested by the figures given." This statement coming from a person of Minot's wide experience must be significant. It is hoped that the analysis of a tremendous series of carefully recorded cases, as one may expect eventually to find in the Lymphoid Tumor Registry, will give us the correct prognostic value of external involvement.

The tumor bearing sites *below the neck* were the breasts, axillary nodes, inguinal nodes, buttock, lower limbs, etc. *Above the neck* the scalp was frequently the seat of the neoplastic process, but it was striking how often the pharynx seemed to be the primary focus.

In none of Cutler's cases is there mention of superficial lesions other than in the neck. Apparently his cases with carcinoma metastatic in the cervical lymph nodes had involvement of the internal viscera without further manifestation upon the superficial areas of the body. Perhaps this can be employed as a point in differential diagnosis between certain epithelial and lymphoid tumors when they present themselves as a lymphadenomegaly.

The study of *internal sites* must be left for an autopsy or exploratory series and will not be undertaken at the present time.

Apparently the total duration of symptoms is related to the type of disease rather than to

TABLE IX—TREATMENTS BEFORE COMING TO THE HOSPITAL*

| | Surgery | X ray | Radium | Local applications | Ultra violet | No treatment cases |
|------------------------------|---------|-------|--------|--------------------|--------------|--------------------|
| Reticulum cell lymphosarcoma | 3 | 1 | | 1 | | 16 |
| Atypical cell lymphosarcoma | 3 | 1 | | 1 | 1 | 4 |
| Chronic lymphogranuloma | 1 | 1 | 1 | — | — | 1 |
| Average | 7 | 3 | 1 | 2 | 1 | 21 |

*Not on a percentage basis.

the method of treatment, for (see Tables IX and X) the therapy applied in the various cases was along the same general lines. All the patients died.

By comparing Table VIII with Table VII one may infer that the general condition of the patient, when he presented himself at the hospital, was inversely proportional to the duration of the symptoms. In the granuloma the general condition was poor in 100 per cent of the patients, and yet the duration of symptoms before coming to the hospital was one half of that in the 2 other groups. It may well be that the more ravaging the disease the earlier is medical advice sought and the more likely is the physician led to send the sufferer into the hospital.

Table IX illustrates the variety and number of treatments that the patients had before coming to the hospital. This is not on a percentage basis, for it is to be remembered that perhaps one patient might have several sorts of therapy and another might have only one. Sixteen of the twenty-one reticulum cell cases had no treatment. This holds true in 4 of the 10 atypical cell and in 1 out of 4 of the granuloma patients. Thus most of the cases were subjected to no therapy whatsoever.

After admission to the hospital, radium was the most frequently employed agent and X ray came second. Surgery, except to procure biopsies, was not resorted to. Many of the X-ray treatments were administered with the low voltage machine before the advent of the high voltage apparatus. As a rule the radium was applied in large doses from a distance. In three instances Coley's toxins were resorted to.

In the great majority of cases the size of the tumors was markedly reduced. By compar-

TABLE X—TREATMENTS AFTER COMING TO THE HOSPITAL*

| | Radium | X ray | Clev s torus |
|------------------------------|--------|-------|-----------------|
| Reticulum cell lymphosarcoma | 16 | 3 | 3 |
| Atypical cell lymphosarcoma | 6 | 8 | — |
| Chronic lymphogranuloma | 3 | 3 | — |
| Average | 25 | 16 | 3 |

*Not on percentage basis

TABLE XI—SUBSEQUENT COURSE—PERCENTAGE

| | Regress-ion | No regres-sion | Not stated |
|------------------------------|-------------|-------------------|---------------|
| Reticulum cell lymphosarcoma | 71 | 5 | 24 |
| Atypical cell lymphosarcoma | 90 | — | 10 |
| Chronic lymphogranuloma | 100 | — | — |
| Average percentage | 87 | 2 | 11 |

ing Table XI with Tables VII and XII, one finds that the more malignant the process the better was the initial response. Pursuing this thought further one might assume that in a given case the amount of regression of the masses varies inversely with the length of life remaining to the sick person. In other words, may one not say that the better the response to radiation the poorer is the prognosis so far as duration of life is concerned? There is no doubt but that the patients were made more comfortable for a time, and from the standpoint of symptomatic palliation one is impressed with the beneficial effects. This coincides with the observations made by Minot and Isaacs (8).

One may safely assume that the mortality was 100 per cent in each group. Everybody that was lost track of was in very poor condition when last seen. This statement is further supported by the fact that in the current files for lymphosarcoma of the neck in the Memorial Hospital there is no living patient of more than 3 year's standing in which the diagnosis was made or confirmed by its own department of pathology. This excludes those cases diagnosed in other institutions unless the section was later seen by the pathologist of the Memorial Hospital and adequately confirmed. Of course, in any large series one may find cases living for more than 3 years after the beginning of symptoms, but as Minot has so well expressed it, we do not know but that those are the cases which nature intended to live a long time. It would seem that our treatments have no proved effect on the duration of life. Cases extending beyond the 3 year period must be rare if the diagnosis has been confirmed by a competent and conservative pathologist.

All cases in this series had biopsies. In 7 of the 21 cases of reticulum cell lymphosarcoma,

TABLE XII—FINAL RESULTS—PERCENTAGE

| | Dead | Lost track of |
|------------------------------|------|------------------|
| Reticulum cell lymphosarcoma | 81 | 19 |
| Atypical cell lymphosarcoma | 80 | 20 |
| Chronic lymphogranuloma | 100 | — |
| Average percentage | 87 | 13 |

the patients were subjected to biopsies before coming to the Memorial Hospital. In 2 of these there were incisions into the pharyngeal mass. One of these lived only 6 months and the other 8 months from onset of symptoms. This is much lower than the average (21 months) for the reticulum cell group. But if one computes the average of the 7 cases which had biopsies before coming to the hospital, including the 2 with incisions into the mass, the average duration of life is found to be 24 months. Although incisions into lymphoid tumors may be unjustifiable and dangerous, it does not seem that one is justified in condemning properly taken biopsies without adequate supporting data. Biopsies taken early in the disease as compared with those secured at a later stage seem to have no deleterious influence.

A few interesting features will be noted. Two women had definite involvement of the breasts. They lived a very short time. One patient had repeated operations over a period of 10 years in order to remove recurrent "tumors" in the oral pharynx. Finally she had definite, but atypical, lymphosarcoma at the base of the tongue. One case presented a nodular liver and jaundice. Splenomegaly was observed in one individual.

SUMMARY

A tentative classification has been adopted but only in order to make the present study. In general it conforms to that of Ewing's, *ie*, where possible, being based on histogenesis. In

the past decade there has accumulated sufficient evidence to warrant the statement that certain carcinomata metastatic to the cervical lymph nodes may simulate lymphoid tumors both histologically and clinically. Of these there seem to be two groups as far as structure goes. One has been designated "lympho-epitheliomata" by the French school, and the other has been called "transitional cell epidermoid carcinomata" by some American writers. Ordinarily the former carries with it a generous admixture of lymphocytes, and the epithelial cells (often in syncytial masses) are larger and paler than in the latter group. Both are radiosensitive, have a very small primary tumor (in the nose, pharynx, or mouth), metastasize to the cervical lymph glands (that being ordinarily the first evidence of disease) and thence to the bones and internal parts of the body. The reason for calling attention to these carcinomata is because in the present study they have been found to constitute 10 per cent of the cases filed as "lymphosarcoma" of the neck.

The difficult problems presented in the histological diagnosis of lymphoid tumors have been partly pointed out. The solvability presents more obstacles in the so called lympho-granulomata than in the lymphosarcomata. The former have a more complicated structure because they may appear to be chronic in inflammatory reactions and yet present features of autonomous growth.

The author believes that the present chaos existing in the group of lymphoid tumors can best be relieved by a general patronage of the Lymphoid Tumor Registry, Army Medical Museum, Washington, D. C.

A clinicopathological analysis is made on a small, restricted group of tumors in the hope of demonstrating subgroups. It remains to be seen whether these will hold on a large number of lymphoid tumors appearing in various parts of the body. On account of the relative frequency in the present series, the reticulum cell lymphosarcoma, the atypical cell lymphosarcoma, and the chronic lymphogranuloma have been selected for the analysis (for their description see explanation of Table I).

The granulomata occurred in older people, were in women, and presented bilateral in-

volvement of the lymph nodes of the neck in 75 per cent of the cases. Differences were also noted between the other two groups.

In the various classes of tumors the more extensive the external involvement the shorter was the duration of life. Probably this is because the external involvement vanes directly with the internal involvement, and this point should be determined in a large autopsy series. At any rate, the amount of external involvement is easily ascertained and seems to have a certain prognostic value. As a differential point between carcinomata (see above) and the lymphoid tumors, evidence of the disease in superficial parts of the body, other than the neck, would be in favor of the lymphoid neoplasm, and it appears that bilateral involvement of the cervical lymph nodes is less common in the carcinomata. Judging from the available literature, the carcinomata tend to metastasize internally without further external manifestations.

A study of the lymphoid tumors indicates that the progress of the disease is related to the type of cell rather than to the type of treatment instituted. The reticulum cell, the atypical cell, and the granuloma taken as separate groups show 21, 16, and 11 months, respectively, as an average total duration of life from the onset of symptoms. Most of the patients had no treatment before coming to the hospital other than the taking of biopsies and the desultory giving of radiation. After hospital admission biopsies were taken on all cases in which sections had not been secured outside of the hospital or where these were not available for confirmation. Otherwise surgery was not resorted to. Radiation was instituted in all the therapeutic regimens. Large doses of radium applied from a distance was employed more frequently than the X ray.

In addition to the differences enumerated, the reticulum cell lymphosarcoma in comparison with the chronic lymphogranuloma showed less external involvement, better general condition upon admission, and less regression in the size of the tumors treated. Between the extreme limits of these two groups lay the atypical lymphosarcoma. As a general thing the more malignant the cell type, better was the initial tumor response to

the radiation, and shorter was the duration of life. This leads one to assume that the more prompt and the greater the reduction of the radiated tumor the less time will the patient live. As has been emphasized by Minot and Isaacs, it is very doubtful if the treatment of lymphoid tumors does more than to make the patients more comfortable during the time that they live.

In all cases followed to the end (Table XII), there was a probable mortality of 100 per cent. In the few that were finally lost track of, the general condition of the patients leaves no doubt that they shortly thereafter succumbed to the disease. Furthermore, in the current files of the Memorial Hospital (at the time this data was collected) there could be found no undoubted case (this means an adequately confirmed histological diagnosis in the hospital's own department of pathology) of more than 3 years' standing. This is a gloomy outlook but seems warranted at the present time. However, one must recognize that there is the occasional case which may live longer, but this is probably due to the natural history of the malady in that particular individual rather than to the institution of treatment.

In the reticulum cell lymphosarcoma group, the average total duration of life in 7 patients having biopsies before coming to the hospital was slightly more than in the 14 remaining who were subjected to the same process after coming to the hospital. In addition to this meager bit of evidence, one could never deduce from any of the records studied in the entire series that the taking of biopsy speeded the progress of the disease.

As a matter of record a few interesting features have been set down.

CONCLUSIONS

1 In cervical lymphadenomegaly one finds a small number of carcinomata which clinically and histologically closely mimic the lymphoid tumors. As a clinical differential point the amount of external involvement, especially in superficial areas other than the neck, seems of value in the present series.

2 A clinicopathological analysis of 35 cases of so-called lymphosarcoma of the neck re-

veals a group difference in the total duration of disease life, the general condition of the patient, the response of the tumor to radiation, the amount of external involvement, and perhaps the age of the patient. But in each group the mortality was eventually 100 per cent.

3 Histologically one may prognosticate the total duration of illness from the cell types. Clinically one may evaluate the length of life from the age of the patient, the amount of external involvement, and the general condition of the individual.

4 Histological and clinical data may be correlated. The rate of the disease progression depends upon these factors rather than upon the type or amount of radiation treatment. In fact the better the initial response of the tumor the shorter the duration of life.

5 The histological structure of the lymphogranulomata is more complex and harder to elucidate than that of the lymphosarcomata.

6 Biopsy taking early in the disease as compared with that at a later date is not believed to shorten the patient's life.

7 On account of the present chaos it is suggested that the Lymphoid Tumor Registry, Army Medical Museum, Washington, D. C., be given generous support.

The author wishes to thank the authorities of the Memorial Hospital for permission to study and utilize the data upon which this article is based.

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THE EFFECT OF TREATMENT IN CASES OF CARCINOMA

A STUDY OF ALTERATION OF MALIGNANCY IN METASTATIC GROWTHS AFTER REMOVAL OR IRRADIATION OF PRIMARY GROWTHS¹

RALPH G. MILLS, M.D., JOND DU LAC, WISCONSIN
ALBERT C. BRODERS, M.D., ROCHESTER, MINNESOTA
The Mayo Clinic
AND

HAROLD D. CAYLOR, M.D., BLOTTON, INDIANA

THE chief application of the system of grading cases of carcinoma has been to determine the degree of malignancy and to estimate the contingent prognosis for curability and life expectancy. The discussion it has provoked has had the desired effect of focusing attention on the possible significance of cellular differentiation and of causing means for its determination to be developed. In certain instances, even within the period of this study, the criteria have been altered to some degree, and emphasis has come to be placed on characteristics not before sufficiently appreciated. This is all in the line of progress, and further elaboration and wider application are to be welcomed.

It occurred to us to apply this method in the analysis of some of the factors involved in surgical procedures. It was thought that possibly we had found a method by which to evaluate the effect that these procedures seem to have on malignant growths.

The data on which this study is based were derived from the protocols in the Section on Pathologic Anatomy of The Mayo Clinic, and the slides on file there. The period covered included the years 1926 to 1928, inclusive. Only cases were considered in which metastasis was found, and sections to illustrate them were obtained. A slide from the primary tumor, taken either at necropsy, from an operative specimen or from a specimen obtained

for biopsy, was essential as a basis of comparison with the various metastatic growths.

For convenience the cases were classified into twelve groups according to the organs in which the primary tumors appeared (Table I), and covered a total of 225 cases. These were exemplified by 1,625 slides, permitting examination of 49 specimens from the primary tumor obtained for biopsy, of 222 specimens from primary tumors obtained at operation or necropsy, and of 661 specimens from metastatic growths obtained either at operation or necropsy, a total of 932 situations. This gives an average of a little less than two slides for each situation.

METHOD OF STUDY

The slides representing a given situation were clipped to a card which bore the necropsy number, for identification purposes, and on which was indicated the site of the primary tumor and the origin of the material shown in the slides. The cards were submitted for grading, one situation at a time, to one of us (Broders) with whom, for a time, was another (Caylor) as collaborator. Opportunity was not afforded at any time for comparison of one situation with another from the same case. Diagnosis and grading were, therefore, conducted on a purely objective basis. The number of cases was so great and the chance of remembering a given case so slight that we

¹Work done in the Sections on Pathologic Anatomy and Surgical Pathology, The Mayo Clinic, Rochester, Minnesota.

TABLE I—SUMMARY OF THE ENTIRE SERIES AND OF THE RESULTS OF GRADING THROUGH THE SECOND SURVEY

| Situations of primary tumors | Cases | Slides studied | Grades uniform on first examination cases | | | | | Grades uniform on second examination cases | | | | |
|------------------------------|-------|----------------|-------------------------------------------|---------|---------|---------|-------|--------------------------------------------|---------|---------|---------|-------|
| | | | Grade 1 | Grade 2 | Grade 3 | Grade 4 | Total | Grade 1 | Grade 2 | Grade 3 | Grade 4 | Total |
| Rectum | 26 | 128 | | | | | 7 | 2 | 4 | 5 | 4 | 15 |
| Colon | 43 | 221 | | 6 | 6 | 5 | 17 | | 9 | 4 | 2 | 15 |
| Stomach | 49 | 320 | | | 3 | 22 | 25 | | 2 | 4 | 0 | 15 |
| Esophagus | 8 | 47 | | 1 | | 4 | 5 | | | 1 | | 1 |
| Lung | 12 | 155 | | | | 5 | 5 | | 1 | 1 | 2 | 4 |
| Breast | 8 | 88 | | | | 3 | 3 | | | | 4 | 4 |
| Uterus | 11 | 90 | | 1 | 1 | 6 | 8 | | | 3 | | 3 |
| Bladder | 10 | 87 | | | 1 | 5 | 6 | | 2 | | 1 | 3 |
| Prostate gland | 8 | 62 | | | 1 | | 1 | | | 1 | 2 | 3 |
| Gall bladder | 13 | 101 | | 1 | 4 | 1 | 6 | | | 2 | 1 | 3 |
| Pancreas | 14 | 130 | | 1 | | 4 | 5 | | 2 | 2 | 1 | 5 |
| Miscellaneous | 23 | 196 | 1 | 1 | | 3 | 5 | | 3 | 2 | 6 | 11 |
| Totals | 225 | 1625 | 1 | 14 | 10 | 50 | 65 | 2 | 23 | 25 | 32 | 82 |

confidently assert that the examination represented an unbiased diagnosis based on the sections presented. In some instances, the small amount of tumor present, the effect of secondary changes in the tissues, and the state of preservation, made the grading very difficult. However, in the tabulation of the results, no allowance has been made for these difficulties.

While this study was being made a slight change took place in the criteria by which to grade adenocarcinoma. The chief point to note in this connection is the stress that is now placed on the characteristics of the cells, and the little, if any, stress that is placed on the mucoid material which many of the cells elaborate. This is the reason for many of the changes in grading which, as will be seen, were made when re-examination of some of the slides was made.

In Table I may be seen the number of cases found in each of the twelve groups and the slides available in each. Those in which all slides from the different situations of a given case were diagnosed as being of the same grade totaled 93.

After all slides from the different situations had been graded, those cases in which discrepancies occurred were again submitted for

study, but this time all slides from the same case were submitted together.

Uniformity of grading of specimens from the different situations was not obtained on the first examination in 132 cases. Those cases which were brought into uniformity by changes in the grade on the second examination are analyzed in Table I. In a total of 82 cases, the gradings of 124 slides were thus changed, an average of about one and a half alterations for each case. It will be noticed that a large proportion of the tumors which were recognized consistently at the first examination were graded 4. Many more, proportionately, of those which ultimately were graded 2 and 3 required alteration. Many of the slides thus altered had been graded "high 2 or low 3," indicating that they were close to the borderline between two grades.

A total of 151 slides (from 132 cases) were altered in grade. As has been pointed out, 124 of these slides concerned the cases in which grading was thus made uniform. In a total of 50 cases grading still was not uniform after second survey, although in 27 slides in this group it was possible to make changes in grade. It should be added, also, that some of these changes increased rather than decreased the differences between the grades assigned.

TABLE II—SUMMARY OF CHANGES IN GRADE MADE IN 151 SLIDES FROM 132 CASES, INCLUDING THE 50 CASES IN WHICH GRADING STILL WAS NOT UNIFORM AFTER THE SECOND SURVEY

| Situations of primary tumors | Slides | | | | | | | | | | Cases with per- sistent varia- tions in grade |
|------------------------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|---------------|-------|-----------------------------------------------------|
| | Grade 1 to 2 | | Grade 2 to 3 | | Grade 3 to 4 | | Grade 4 to 5 | | Total | | |
| | Grade 1 to 2 | Grade 2 to 3 | Grade 3 to 4 | Grade 4 to 5 | Grade 5 to 6 | Grade 6 to 7 | Grade 7 to 8 | Grade 8 to 9 | Grade 9 to 10 | Total | |
| Rectum | 1 | 2 | 7 | | | 5 | 5 | 2 | 11 | 4 | |
| Colon | 1 | | 4 | | | 9 | 7 | 5 | 26 | 11 | |
| Stomach | 1 | | 3 | 1 | | 3 | 13 | 3 | 26 | 6 | |
| Esophagus | | | 2 | | | | | 1 | 3 | 3 | |
| Lung | | | 2 | | | 4 | 4 | | 9 | 3 | |
| Breast | | | | | | | 6 | 1 | 8 | 1 | |
| Uterus | | | 3 | | | | | 2 | 5 | | |
| Bladder | | | 1 | | | 5 | 1 | | 8 | 1 | |
| Prostate gland | | | 1 | | | | 3 | | 4 | 4 | |
| Gall bladder | | 1 | 6 | | | | 2 | 1 | 10 | 4 | |
| Pancreas | 1 | | 2 | | | 3 | 1 | 2 | 10 | 4 | |
| Miscellaneous | | | 2 | | | 8 | 7 | 3 | 20 | 7 | |
| Totals | 5 | 3 | 32 | 1 | | 37 | 51 | 11 | 151 | 50 | |

TABLE III—CHANGES IN GRADE MADE IN THE SECOND SURVEY

| Situations of primary tumors | Specimens obtained for biopsy | | Specimens of primary tumors obtained at operation or necropsy | | Specimens of metastatic growths obtained at operation or necropsy | |
|------------------------------|-------------------------------|---------|---------------------------------------------------------------|---------|-------------------------------------------------------------------|---------|
| | Total | Altered | Total | Altered | Total | Altered |
| Rectum | 4 | 1 | 26 | 0 | 47 | 12 |
| Colon | 5 | | 43 | 5 | 85 | 16 |
| Stomach | 6 | 1 | 40 | 7 | 115 | 15 |
| Esophagus | 1 | | 8 | 1 | 21 | 1 |
| Lung | 3 | 1 | 11 | 1 | 64 | 6 |
| Breast | | | 7 | 1 | 45 | 7 |
| Uterus | 10 | | 10 | | 35 | 5 |
| Bladder | 8 | | 10 | 1 | 35 | 6 |
| Prostate gland | 1 | 1 | 8 | | 17 | 5 |
| Gall bladder | 4 | | 13 | 1 | 45 | 8 |
| Pancreas | | | 11 | 3 | 56 | 7 |
| Miscellaneous | 6 | 2 | 22 | 5 | 76 | 13 |
| Totals | 49 | 7 | 171 | 35 | 661 | 100 |

The nature of these changes, including those in the group of 50, is indicated in Table II. An alteration from a lower to a higher grade was made in 90 instances, and from a higher to a lower grade in 61. This difference in the figures suggests that, for one reason or another, the slides tended to indicate a lower, rather than a higher, grade of malignancy.

There were cases of carcinoma in every organ except one of those listed, in which grading was not reduced to uniformity by the second survey. This exceptional group of carcinomata involved the uterus, which will be considered later.

In the second survey it was deemed necessary to alter the grading of specimens obtained for biopsy as well as of specimens of primary tumors obtained at operation or necropsy, in view of the study of each entire case. The number of changes of this sort is shown in Table III. The ratio of approximately one change in grade in seven diagnoses was maintained throughout the examinations of slides of specimens obtained from primary tumors

for biopsy, from primary tumors at operation or necropsy, or from metastatic growths at operation or necropsy.

In Table II, it may be noted that almost all the changes involve a shift from one grade to an adjacent one. There are two exceptions to this statement, and both are found in the series of gastric carcinomata. The reason for the shift of two grades instead of one, as in all other instances, was sought by a special study of the cases in question. In one instance the matter hinged on the significance to be attached to the presence of mucoid material. In the other, the few tumor cells had been crowded into a group of lymphatic vessels which gave to the cellular masses a false cancer appearance.

The group of 50 cases in which uniformity of grade was not secured by the two examinations is probably the most significant in the series. It is conceivable that treatment may have exerted an influence in disturbing the uniformity of growth in the metastatic tumors. If irradiation, or removal of the primary growth, can retard the growth of carcinomatous cells or can remove a stimulus by which their growth is accelerated, then full recognition of these facts should be given.

The only criterion of such retardation or acceleration that can be evaluated in this study is that which is manifest by alteration in histological structure. Failure to detect such changes, as indicated by morphological response, suggests that prolongation of life may be attributable to changes in the animal body rather than in the parasitic carcinomatous cells. To this end, a study was made to estimate the influence exerted by irradiation and by removal of the primary growth to the extent that the data justify.

Some form of irradiation was used in 33 cases of this series, roentgen-rays only were used in 16 cases, radium only in 7, and both roentgen-rays and radium in 10. Details of treatment by irradiation were supplied by Desjardins and Bowing. In the smaller series of 50 cases in which persistent variations in the grade of the tumors was displayed, irradiation had been applied in only two, they were both cases of adenocarcinoma of the kidney, and roentgen-rays only had been applied. The number of cases in this series of 50 in which treatment was given seems to be disproportionately low (4 per cent) as compared with 14 per cent of the entire series. If irradiation inhibits the growth of metastasis of tumors, it apparently does not do so by altering the virulence of the cells to the extent of lowering the grade of malignancy. But in the two cases just mentioned the virulence of the cells did seem to be altered. The primary tumors were graded 2. One metastasized and was graded 3, and metastasis from the other was graded 4 in all situations except one, in which it was graded 2.

As has been recorded, instances in which variation in grade persisted after re-examination were found in tumors of all the twelve groups of organs in which the primary growths occurred, except those of the uterus. Of the whole series of 225, 11 patients had tumors of the uterus. Nine of these had received some form of irradiation, some of them had been repeatedly treated. In one case the carcinoma, which had arisen in the cervix, had been completely destroyed by this means. However, in the course of the treatment, the grade had been determined three times by biopsy of tissue from different but adjacent tissues.

At necropsy, performed 15 months after treatment was instituted, carcinoma was found in 5 situations. In this case all growths except one were graded 3 at the first examination, and this grading was changed from 2 to 3 on restudy.

No alteration in the grade of any specimen obtained for biopsy or of any primary tumor of the uterus was made, and only five changes in 3 cases were made in all the metastatic growths. The result was that eventually the 11 cases presented complete uniformity in the grade of the specimens obtained for biopsy, of the primary tumors obtained at operation or necropsy, and of the metastatic growths obtained at operation or necropsy.

Variations in the degree of cellular differentiation, implying lack of uniformity in the growth of the tumor, have been noted. These have been attributed to inhibitory effects of irradiation on the tumor cells, and have been so observed in series, for the most part derived successively from specimens of the same origin obtained for biopsy and at operation. They have not been adequately controlled by observations on the behavior of tumors in other situations than the uterus. Nor have they been compared with the metastatic growths of such tumors in other situations.

In the present series of tumors of the uterus, the variation within a single slide has been surprisingly slight, and to this fact is due the uniformity in grade at the time of the first examination. In specimens of some of the other organs the variation in grade in a single slide ranged from 1 to 4. A small region sometimes contained masses of cells that, if considered alone, would warrant a diagnosis of malignancy graded 1, and near by, another portion sometimes would be graded 4, various intermediate stages also were found. This variation was noted repeatedly, and many of the alterations were made in those slides in which an attempt had been made to strike a general average, and to compromise on grade 3 or grade 2.

The evidence, then, so far as it goes, shows that irradiation can completely eradicate a primary growth when, like tumor of the cervix, it can be reached by these means. How many patients can be cured by irradiation

TABLE IV.—COMPARISON OF PRIMARY TUMORS AND OF CORRESPONDING METASTATIC GROWTHS IN 32 CASES WITH PERSISTENT VARIATION IN GRADE

| | Primary tumor grade | Growths in lymph nodes grade | Metastatic growths outside of lymph nodes grade |
|----------------|---------------------------------|------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------|
| Rectum | 4 4 3 3 | Regional 3 Regional 3 Regional 3 Regional 3 | Lungs 3 Liver 3 peritoneum 3 ileum 3 bladder 4 Liver 3 peritoneum 3 |
| Colon | 3 4 3 3 3 3 3 | Regional 3 Hilar 3 Regional 3 | Liver 3 pancreas 3 Liver 3 Liver 3 Colon (recurrence?) 3 Lungs (liver) 3 liver 4 Lungs 3 ileum 3 Liver 3 |
| Stomach | 4 3 3 3 | Regional 3 Regional 4 Regional 4 | Liver 4 pancreas 3 colon 3 |
| Esophagus | 4 3 | Regional 4 Regional 3 abdominal 3 | Pancreas 3 spleen 4 Lungs 3 liver 4 heart (left ventricle) 4 |
| Lung | 4 | Regional 4 | Lungs 3 liver 4 brain 4 suprarrenal glands 4 kidney 4 |
| Breast | 3 | Regional 3 | Lungs 3 liver 4 pituitary 3 thyroid 3 skin 3 pleura 3 other breast 3 |
| Iliac | 4 | Regional 4 | Lungs 3 liver 4 stomach (primary?) 4 spleen 4 skin 4 suprarrenal gland 4 thyroid gland 4 kidney 4 pancreas 4 gall bladder 4 |
| Prostate gland | 3 3 3 | Regional 3 Regional 3 Regional 4 | Lungs 4 Lungs 3 prostate gland (recurrence) 3 |
| Gall bladder | 3 | Regional 3 | Lungs 3 liver 3 common bile duct 3 |
| Pancreas | 4 4 3 | Regional 4 Regional 4 Regional 4 | Lungs 3 liver 4 Lungs 3 liver 3 portal vein 3 Liver 3 duodenal ulcer 3 cystic duct 3 ant. 3 suprarrenal gland 3 (1 3) |
| Miscellaneous | 4 3 3 3 | Regional 4 Regional 4 mediastinal 4 | Lungs 3 liver (ileum or liver primary) 3 Lungs 4 hypernephroma 3 Lungs 4 brain 4 tox (hypernephroma) 3 Lungs 3 mediastinum 3 veins of neck 3 |

must be demonstrated by studies radically different from this. The unusual uniformity in grade of tumors of the uterus suggests that cells which remain viable in spite of irradiation may not be altered in their histological appearance. Local variations in cellular differentiation may indicate a type of inherent unrest but do not prove that irradiation can modify the type of growth that takes place in metastasis. Histologically the cells maintain to an unusual degree the characteristics manifested in the primary growth.

In 57 cases the primary tumor was removed, and in 11 of these persistent variation from the grade of the primary tumor was found in the grading of the metastatic growths. Most of the primary growths in these 11 cases occurred in the groups of organs designated as the rectum, colon, stomach, breast, and mis-

cellaneous viscera. Only 5 of the 11 patients lived more than 1 month; the series, therefore, is too small to warrant further study. It was noted, however, that there was a tendency for the metastatic growth to carry a higher grade of malignancy than the primary tumor in most of the 5 cases in which the patients lived for the longer periods. The 6 remaining patients lived such a short time after operation that removal of the tumor could have had no appreciable influence on the metastatic growths.

When there is lack of uniformity in the grading of a primary tumor and of the metastatic growth or growths that originate from it the first question raised is that of the existence of multiple primary malignant growths. The series of 50 cases in which uniformity of grade was not secured by re-examination,

therefore, was restudied with this point in mind. Exceptionally, one tumor may present such irregularities or variations in its growth as to justify one grade in one situation and another grade in another situation. Presumably, however, there would be a general similarity in the growth in all situations, the chief, or perhaps the only, difference observed would be in the extent of the differentiation of individual cells. Usually, metastatic growths from a single source would not be composed of glandular cells in one portion and of squamous cells in another. Yet it is known that this does occur, and it did occur in several instances in metastatic carcinomata derived from growths of the gall bladder and the bronchi. However, they were considered in the present study as having been derived from the same source.

In several instances, a primary adenoma, in which carcinomatous change had occurred, was found in the intestine, and this had given rise to perhaps one metastatic growth. However, there was a larger primary tumor elsewhere. Such a case was discarded because of the confusion which it was likely to cause.

In a few cases, a metastatic growth was encountered that differed materially from the known primary tumor and had suggestive resemblance to carcinoma arising in such an organ as the thyroid gland. The protocol might indicate that the thyroid gland had been examined, but to rule out the possibility that the metastatic growth was derived from a carcinoma of the thyroid gland is at present impossible. Although a special system was in operation to reduce the possibility of mixing and misplacing slides nevertheless this possibility must be taken into consideration and due allowance made for it.

The question arose several times as to the presence of two tumors of the same kind and similar grade. To analyze these fully would carry one too far afield. Multiple tumors of different grades were studied only to determine that two tumors really existed, rather than to seek an explanation for difference in grade on the basis of variation in the growth of one.

It is perhaps unnecessary to state that cases in which diagnosis of multiple tumors had been made at necropsy were excluded from

this study. It was the assumption in all cases retained in the series that a single primary tumor had given rise to the metastatic growth that was encountered. For one or more of these reasons, 18 cases were discarded from the 50 in which variation in grade persisted on re-examination, leaving in the series a total of 32 cases in which grading could not be made uniform (Table IV).

The variations in grading within a given case gives one certain distinct impressions. In 11 of the 32 cases (Table IV) metastasis in regional lymph nodes was not discovered. Of the remaining 21 cases, the grades of primary tumors, as compared with the grades of metastatic tumors in the regional nodes, were the same in 9 cases, and were more or less malignant in about equal proportions of the remaining 12. A step upward of one grade was noted in 5 cases and of two grades in 2 cases. There was also a step downward of one grade in 4 cases and of two grades in 1 case. Metastasis in other than the regional nodes was not so common as to warrant conclusions.

Metastasis was found in the lungs in 16 of the 32 cases. The grading as compared with the primary tumor was the same in 5 cases, it was raised one grade in 2 cases, and two grades in 2 cases. It was decreased one grade in 5 cases, two grades in 1 case, and three grades in 1 case. There seemed to be a tendency for some carcinomata to become a little less malignant when they became implanted in the lungs.

Metastasis to the liver was found in 17 cases. In 7, the grading was the same in the liver as in the primary growth. In 4 cases it was one grade lower, and in 1 case two grades, it was elevated one grade in 5 cases. There seemed, then, to be about the same number of cases in which an increase in evidence of malignancy took place as there were cases of evidence of decrease in malignancy.

The number of situations in which these 32 tumors were studied varied from two to eight. The number of situations in which the grade of malignancy of the metastatic growth varied from that of the primary growth was in 21 cases confined to a single slide. Of slides in which the grade of malignancy was at variance with that of the primary growth, in 6

spasticity. A large mass corresponding in size to that of a fist was felt in the right upper quadrant, this mass was irregular and pear shaped in outline. It appeared to move with respiration was not tender, and seemed to arise from the gall bladder.

Laboratory findings. The urine was essentially negative, the red blood cells numbered 4 000 000, the white blood cell 8 000, and hemoglobin 50 per cent.

Operation was performed on July 23, 1930. A right rectus incision was made to explore the gall bladder. The latter was found very much enlarged and contained a tumor mass which extended downward and embraced the transverse colon at the hepatic flexure. The gall bladder was detached from the liver and from its attachment to the colon with a moderate degree of ease. The abdominal wall was then closed in layers.

Pathological examination of the gall bladder (Fig 1) revealed a very much enlarged organ measuring 11 centimeters in length. The serous surface was ragged and the wall considerably thickened. The greatest degree of thickness was noted in the fundus. When the gall bladder was opened the cavity was found to contain numerous stones of various sizes. The mucous surface presented a purplish discoloration excepting at the region of the fundus where it was more of a grayish white color and grossly appeared like carcinoma. Areas of necrosis and softening were found in the latter situation.

Microscopic sections taken from the inflamed areas of the gall bladder distant to the tumor revealed various changes. The surface epithelium was for the greater part denuded and where still intact it was either one or several cell layers deep. The wall was considerably thickened because of edema and abundant connective tissue formation. The latter was densely infiltrated with leucocytes and lymphocytes.

Sections taken from the wall of the gall bladder closer to the tumor showed in addition to the inflammatory reaction described, infiltration of the detached surface epithelium into the deeper layers of the wall. The former were arranged in duct like structures and were found to invaginate the entire thickness of the wall reaching as far as the serosa. These structures are known as the Aschoff-Rokitansky sinuses and are not uncommonly found in gall bladders that have been the seat of chronic inflammation. Some of the sinuses found in this gall bladder were lined by only one layer of cylindrical epithelium while others were several cell layers deep. In the latter case the morphological character of the epithelium was changed from the normal and in places exhibited numerous mitotic cell divisions. In these sinuses there was evidence of the first change from the normal to the abnormal epithelium, while at a point still closer to the tumor the sinuses appeared as definitely malignant and resembled a duct carcinoma. Another interesting feature noted here was a sudden change in the histological appearance of some of the epithelium lining the sinuses, namely a transformation of the cylindrical epithelium into a

squamous cell carcinoma. The microscopic picture was therefore that of a combined cylindrical and squamous cell carcinoma (Fig 2). Sections obtained from the main tumor mass revealed entirely a squamous cell carcinoma with characteristic pearl formation. In these latter areas the tumor has lost entirely its cylindrical cell character and had been transformed into a purely squamous cell malignant neoplasm (Fig 3).

We find therefore in this gall bladder several interesting changes resulting probably from a common etiological cause. In the first place there is the presence of inflammation and stone formation apparently of long duration judging from the increased thickness and pathological changes of the wall in addition to the well formed stones. Second there is the presence of a combined cylindrical and squamous cell carcinoma, the latter being completely differentiated in the main tumor mass.

The various histopathological findings noted in this gall bladder are rather interesting and shed valuable light on the relationship existing between chronic inflammation, stone formation, and carcinoma, as well as on the problem of the histogenesis of squamous cell carcinoma of the gall bladder and epithelial metaplasia. Since the true etiology of the disease is not determined one is reduced to speculations regarding the mode of dependence of the tumor process upon the irritant. It is almost an undisputed fact, however, that irritation resulting either from chronic inflammation, stones, or both, plays a very important rôle in the development of carcinoma of the gall bladder. According to Rolleston, at least 4 to 14 per cent of all people suffering from cholelithiasis develop carcinoma of the gall bladder. In numerous microscopic sections taken from inflamed gall bladders either with or without stones, we have found evidence of active proliferation of the mucosal epithelium. In addition, some of this epithelium has detached itself in places from the surface and has become buried in the deeper strata of the wall, reaching at times as far as the serosa. They usually have the appearance of duct like structures or sinuses and the epithelium is often several layers thick. Among these cells mitotic figures are often found, indicating rapid growth. It is quite probable that such epithelial strands in the depth of the wall are the forerunners of new growths, and evidence to that effect has been noted in the gall bladder of our patient (Fig 4). While irritation,

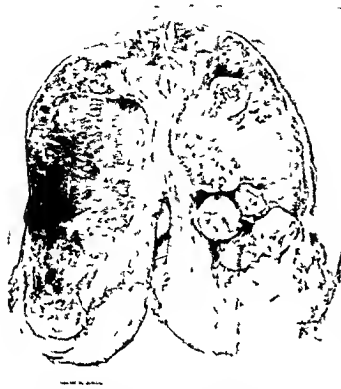


Fig 1 Appearance of gall bladder removed at operation. Note the thickened wall particularly in the region of the fundus where a carcinomatous change has taken place in the wall. The cavity is seen to contain several stones and the mucosa is discolored.

therefore, resulting from chronic inflammation and stone formation offers only indirect proof as to its relation to tumor formation, yet the frequency with which the two occur prompts us to accept it as an important etiological factor.

Of greater importance and interest to us is the development of a squamous cell carcinoma in an organ in which the mucosa is normally lined with columnar epithelium, and in which flat epithelium is at no time present. Although such cases are not very infrequent, their finding attracts great interest. In a recent publication by Roessiger on squamous and mixed cell type carcinoma of the gall bladder, the author ascribes the origin of the squamous cells to the basal cell layer noted in the gall bladder mucosa. Roessiger bases his arguments as to the development of a squamous cell carcinoma in this organ on Krompecher's theory, namely, that the basal cell is multipotent and is therefore capable of developing into either cylindrical or flat epithelium. He found in 21 inflamed gall bladders associated with cholelithiasis, this so called basal cell layer described by Krompecher. He also



Fig 2 Mixed cylindrical and squamous cell carcinoma in the wall of the gall bladder. Note the transformation of the cylindrical epithelium lining one of the sinuses into a squamous cell carcinoma.

found similar cells in the normal gall bladder. Roessiger concludes, therefore, that the squamous cell carcinoma that is occasionally encountered in the gall bladder is a direct derivative of the basal cell layer found in the mucosal lining of this organ.

In a series of normal gall bladders which we have studied we were unable to find such basal cells. However, in pathological specimens, particularly of long standing inflammation and cholelithiasis, we have found a deeper layer of cells in the mucosa which in all probability corresponds to the basal cells described by Roessiger and Krompecher. In this deeper layer of cells mitotic figures were often observed, these cells are probably concerned with cell proliferation and regeneration. At no place, however, was there any direct evidence of transition from cylindrical to squamous epithelium, although such a change might nevertheless occur.

The histopathological findings presented in our case show two distinct morphological



Fig. 3 Squamous cell carcinoma of the gall bladder. Note the character of the epithelium and the typical pearl formation.

changes, first a rather sudden transition from a microscopically normal epithelium to one of a distinctly malignant form and second a structural independence between cylindrical and squamous cell carcinoma. This finding would lead one to assume that the epithelial growths have in all probabilities a common genetic origin and that they are both capable of responding to the same growth stimulant. If we were to conceive then the process of tumor metaplasia in this light we could state definitely that the different configurations noted in a mixed cylindrical and squamous cell carcinoma as exemplified in our case are not separate and distinct tumor entities but different morphological phases of growth of one and the same tumor type. In other words we are probably dealing in such instances with a tumor arising from a common type of cell which under the influence of the irritant has acquired two different histological cell characteristics, namely that of cylindrical and squamous epithelium. Furthermore since the greatest degree of cell proliferation is seen in the deeper basal cell layers we are also inclined to believe that the latter are responsible for either type of tumor formation. According to this assumption, the development of two



Fig. 4 Aschoff-Rokitansky sinuses in the deeper layers of the wall of the gall bladder. This section was taken from another case of cholecystitis and cholelithiasis and it serves to demonstrate how the sinuses once detached from the surface infiltrate into the deeper structures of the wall and in places undergo considerable cell proliferation. Mitotic figures are often found in these cells.

histologically different kinds of neoplasm in the same organ is rendered possible through differentiation of the basal cells into cylindrical and squamous epithelium.

Another interesting question that arises from a case as we have described is the manner in which a squamous cell carcinoma develops from a cylindrical cell epithelium. One wonders whether the cylindrical cells are first transformed into normal squamous cells and then in turn converted into carcinoma, or is the process a direct transformation of the basal cells into a heterologous type of carcinoma. We are as yet unprepared to answer this question definitely, but, from careful microscopic examination of various sections which we have made, it seems to us that this

transition is a direct one. At no place could we find in the gall bladder any evidence of normal squamous epithelium, and we are therefore inclined to believe that this is a direct transformation of the original cylindrical epithelium into that of a final squamous cell neoplasm.

SUMMARY

A case is presented in which a squamous cell carcinoma of the gall bladder was found, in addition to the tumor in the gall bladder, there was also found evidence of chronic inflammation and stone formation in that organ.

The various phases of cell metaplasia are discussed particularly with reference to the gall bladder.

NOTE.—We wish to express our thanks to Dr H. A. McCordock of the Department of Pathology of Washington University for making our photomicrographs. We are also indebted to Dr A. O. Ambrose for referring the patient to our service.

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FIBROUS PERITONITIS OF NECK OF HERNIAL SAC¹

V I SCHIRAGIR, M.D., AND J T GAULT, M.D. CHICAGO

FIBROSIS within the hernial sac is quite a common occurrence. We are concerned, however, only with the circumscribed ring like fibrosis occurring at the neck of the sac, which has a definite anatomical and pathological significance.

For many years one of us, (V I S.), observed in a fair percentage of cases a definite ring fibrosis at the neck of the sac in indirect inguinal hernias. The ring was always flush with the internal ring, it was very tough, and it was striking in that the rest of the surface of the sac was perfectly smooth and appeared grossly quite normal. It was never found in direct hernia. *A priori*, Schirager was forced to conclude that the ring could hardly be of pyogenic inflammatory origin, since the remainder of the peritoneal surface showed no gross evidence of inflammatory changes. It was further observed that the most severe types of strangulation were those in which the viscus was caught in a tight fibrous ring, making the release laborious and the pathology severe. Replacement of the bowel was always difficult and occasionally impossible, lest the fibrous ring itself be divided before further useless manipulation. A definite circular necrosis was always present in strangulations within a fibrous ring.

The existence, frequency, and damaging influence of this narrow, circular fibrosis at the neck of the sac, obvious to us in many cases, is either seldom or never mentioned in the literature of hernia. At all events, the ring was never exalted to the importance it justly deserves.

Diffuse, inflammatory changes within hernial sacs, however, are pretty well known and recorded.

Pentonitis of hernial sacs, according to Piquet, is more common in umbilical than in inguinal hernias. The inflammatory process may be a part of inflammatory changes within the peritoneal sac, or be limited to the hernial sac only, cases of the latter type being reported by Lemoniet and Theilhaber. B

Schmidt states that localized inflammation in an empty hernial sac is rare, on the other hand Sutter in 1907 reported 30 such cases. Similar cases were reported by Dubs.

The etiology of the inflammatory process may be bacterial, mechanical, or may be due to extension from neighboring structures. Bacteria can readily migrate from the peritoneal surface into an open hernial sac, the latter being merely a diverticulum thereof, cases, however, in which the process is limited to the sac can not easily be explained on bacterial grounds alone. I Kempf, who found adhesive peritonitis within the sac without palpable mechanical or bacterial cause, nevertheless believes that a bacterial process must have operated sometime. Contact of the peritoneal surface of the sac with the intestine and omentum may cause inflammatory changes. A tight fitting truss, various types of injections for the cure of hernia, reported muscular contractions at the internal ring, are the principal mechanical factors. Hernial sacs may be invaded by bacteria by way of infective metastases from distant foci, or be infected by contiguity. In the case of Nusbaum, the inflammation extended from an inguinal lymphadenitis, secondary to urethritis, while in the case of Charnois, it was secondary to appendicitis.

Inflammation within the sac betrays itself clinically by pain, although cases of extensive local peritonitis without symptoms have been described by von Esser. B Schmidt, discussing pathological changes in the sac, considers them the sequence of peritoneal inflammatory changes and classifies them in three groups: serous, fibrinous, and purulent. Occasionally, tuberculosis of the hernial sac antedates fibrosis (Schirager).

George H. Smith remarks that hernial sacs rarely have been sectioned. He undertook the task of sectioning 250 hernial sacs the material coming from various sources. The common finding in his cases was thickened areas of fibrosis beneath the endothelium. Grossly

¹ From the Department of Surgery, Northwestern University Medical School, the Cook County and Mount Sinai Hospitals, Chicago.

they can be seen on the inner surface of the sac, either at the fundus or the neck. In 37 specimens, there was definite evidence of acute inflammation, irrespective of whether the patient wore a truss or not. The youngest patient was 2 years, and the oldest 72 years. Pain was present in many of these cases. There was tuberculosis in one specimen. Smith states that recent hernias show evidence of subacute inflammation of the subendothelial connective tissue, especially if acquired during muscular strain.

The sequence of these inflammatory changes are constrictions and bands of adhesions. Richter, in his classical monograph on hernia, about one hundred years old, recognized and described adhesions in hernial sacs. It is historically interesting to note that Maupas, in 1551, and Ambrose Pare, operated upon and cured hernias simply by dividing fibrous bands within the sac. Jaboulay and Patel describe constrictions within the sac located either at the internal or external ring. In other cases, they observed "multiple constrictions," the result of localized peritonitis. Strangulations of hernial contents by adhesive bands were recognized by Riolan, Littre, Savard, Méry, and others. W. B. De Garmo, of New York, in his monograph on *Abdominal Hernia* refers to certain changes in structure, frequently found in hernia, "important because they frequently are the immediate cause of strangulated hernia." He speaks of tough fibrous rings capable of severe strangulations.

Seward Erdman, in the chapter on hernia, states "very rarely, the sac itself is the constricting factor." Fusion of two peritoneal layers is more apt to occur at the point of the greatest contact, therefore, at the neck. The sequence of the agglutination may amount to a cure. This is the principle of the cure of hernia by injection of irritating substances. The strangulation, or repeated strangulations, which reduce themselves spontaneously, cause moderate peritoneal changes with subsequent fibrosis and ultimate cure.

Fibrous bands may be limited to the lumen of the hernial sac or extend into the peritoneal cavity, they may partition, sacculate, agglutinate surfaces, or give rise to encapsulated

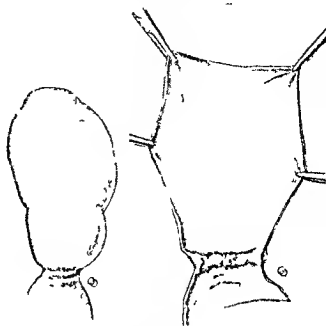


Fig. 1, left Distended unopened sac with constriction at neck.

Fig. 2 Opened sac, showing fibrous ridge at the neck and normal, smooth peritoneal surface of remainder. (Drawn from actual specimen.)

cysts. Painful hernias are to be suspected as having adhesions, which under physical strain exert a pull upon the peritoneum, notoriously sensitive. Fibrous bands may be found in various portions of the sac, some of them, however, are located "at the narrow points, associated with the obliteration of the processus vaginalis" (Watson). After the descent of the testicle, narrow points occur at the internal ring and "a little later" at a point just above the epididymis (Watson). Clough found a strangulation due to a constriction in the tunica vaginalis near the testis. Moschowitz reported three similar cases and Watson reported one. George Gray Turner found a scrotal hernia strangulated at a point 6 inches below the external ring.

Riolan, Winslow, Dionis, and the majority of the members of the Academy of Surgery of Paris, considered fibrous rings as a sole cause of strangulation in hernia. Dupuytren, on the other hand, in his classical lectures, as well as through the writings of Marx (1832) considered strangulation by fibrous bands rather than the exception than the rule. Astley Cooper and other English surgeons also opposed the theory of strangulation by fibrous bands. Malgaigne, although opposed to the theory of

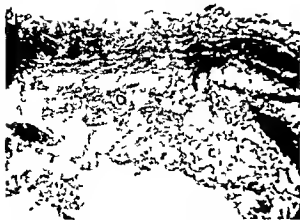


Fig. 3 Section from normal portion of sac (from specimen shown in illustration 2)

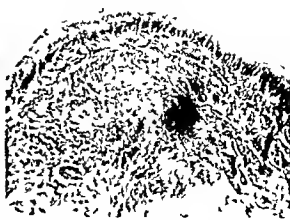


Fig. 4 Section from thickened portion of sac showing greatly increased amount of connective tissue (From specimen shown in illustration 7)

constriction by fibrous bands admitted the possibility of strangulation by fibrous rings in the fascia cribriformis.

The fibrosis we are chiefly concerned with is the narrow tough circular ring limited to the neck of the sac while the remainder of the sac no matter how large, how recent or old with or without previous truss pressure, is smooth and normal in appearance. The process can be well termed fibrous peritonitis. As already suggested, it must be obvious that such circumscribed fibrosis cannot be pyogenic in origin and not leave any traces of inflammation on the rest of the sac surface. It occurred to us that this formation must be traumatic in origin, very likely due to repeated muscular contractions of the internal ring, a kind of

traumatic peritonitis. The mechanical factor must be sought for in the repeated contractions of the conjoined muscle, a purely nervous mechanism against the fixed Poupart's ligament, acting as a "shutter" against the intra abdominal pressure (Keith). Babcock utilized this principle in obliterating the internal abdominal ring by suturing the internal oblique and transversalis muscles to Poupart's ligament. He disagrees with Connell, Marsh Pitzman, and Edmund Andrews who advocate reducing the size of the internal ring. The criticism of Andrews and Connell that the sphincteric action of the internal oblique is lost by suturing it to Poupart's ligament is not tenable according to Rosenblatt and Corksey who believe that by so doing one actually keeps the "shutter" closed.

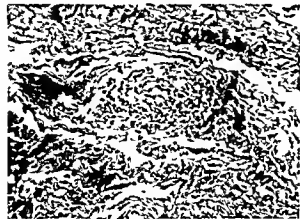


Fig. 5 Same section as Figure 4 highly magnified (Note pervascular round cell infiltration)

While in search for a better explanation of the production of this fibrous ring on a traumatic basis there appeared at this juncture a well documented article by W. W. MacGregor of Detroit, who describes "a true internal inguinal sphincter." We welcomed this description and were hopeful that repeated, voluntary contractions of this "sphincter" could satisfactorily explain the circular fibrosis on traumatic grounds. According to MacGregor "the inguinal sphincter in the dog operated on was found to be a well defined, ring shaped body of muscle fitting snugly around the cord where the latter dropped into the abdominal cavity through the origins of

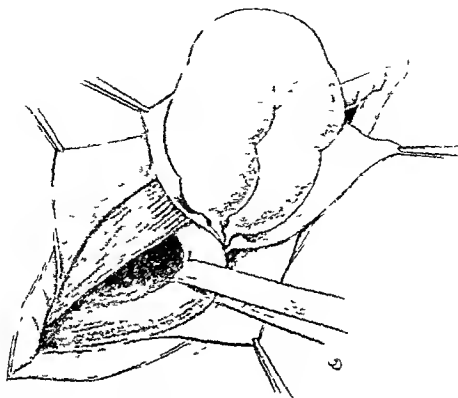


Fig 6 Marked distention of intestinal loop caught in a tight ring

the internal oblique and transversalis muscles" He found a similar sphincter in man and states "It is our contention that the sphincter is demonstrable in all normally developed individuals," "although it was nowhere reported in the literature" The sphincter, thus described, has an independent nerve supply and when stimulated contracts circularly, sufficiently to "diminish markedly the bleeding from a cut in the spermatic artery" Microscopically, the sphincter shows evidence of skeletal muscle

Although the sphincter of MacGregor suited our purpose admirably, we resolved to get acquainted with the structure and see to what extent it could mechanically explain a traumatic peritonitis with ultimate fibrosis of the neck We dissected four old cadavers, three fresh ones, the fresh cadaver of a child and ten dogs, making a total of sixteen inguinal regions in man and twenty in dogs We readily admit the insufficiency of our anatomical material In all our dissections, we merely found that the upper and lateral margins of the internal ring were bounded by the arched

fibers of the internal oblique and transversalis muscles These fibers frequently grouped themselves in two or three distinct circular columns, arching over the cord, especially in dogs In two or three instances, it looked as though they were separated from the main

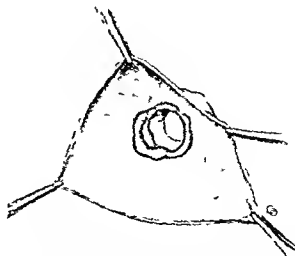


Fig 7 Complete circular ring at neck of sac, showing normal peritoneal surface in rest of sac. (Drawn from actual specimen)

muscles. At no time, however, did these circular columns completely surround the cord. Whenever there was a suggestion of a complete circumference, it was invariably found that the lower half was nothing more than cremasteric fascia and muscle, plus the infundibular fascia and, as such they had no connection with the upper circumference. The arched muscular fibers, even though they do not constitute a complete circumference, undoubtedly are capable of completely shutting off the internal ring and the only credit they are entitled to is that of a "shutter like" or "sphincter like" action as observed by Keith Hammond Darling and others. Even on purely theoretical grounds it was difficult for us to conceive the presence of a sphincter at the internal ring. Throughout the entire human anatomy we cannot find an example of a true sphincter except in tubular or hollow organs. Again, it was scarcely consistent with the prudence and wisdom of Nature to imagine a tiny sphincter entrusted with the task of opposing a mighty intra abdominal pressure. Finally, it would be difficult to conceive a sphincter powerful enough to resist the intra abdominal pressure, completely encircling the cord and not to compress the vessels of the cord during contractions, either to the extent of chronic venous stasis or arterial ischemia.

We are, therefore, compelled to accept merely the "shutter like" action of the internal oblique and transversalis muscles perfectly competent of closing the internal ring. Repeated, physiological contractions of these muscles upon the neck of the sac, we are inclined to speculate, cause a kind of aseptic, traumatic peritonitis, finally expressed in a circular fibrosis at the neck of the sac.

CONCLUSIONS

1. Fibrous peritonitis at the neck of hernial sac is a rather common occurrence.

2. The etiology of this circular fibrous ring at the neck of the sac is, very likely, an aseptic, traumatic peritonitis, the result of repeated muscular contractions at the internal ring.

3. Fibrous peritonitis is responsible for a number of strangulations, the degree of damage being proportionate to the toughness of the ring and the narrowness of the lumen at the neck of the sac.

4. Reposition of viscera in severe strangulations, frequently requires preliminary division of the fibrous ring, both as an aid in replacement and as a safeguard against mechanical damage to the bowel wall and its mesentery.

5. We are unable to identify the internal sphincter of MacGregor, which may be due either to our inexperience in dissection or insufficient anatomical material.

6. The internal oblique and transversalis muscles exert a "shutter like," possibly a "sphincter like" action, which satisfactorily opposes the intra abdominal pressure.

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EXPERIMENTAL STUDIES OF THE EFFECT OF AMYTAL UPON THE FETUS AND ITS TRANSMISSION THROUGH THE PLACENTA OF THE WHITE RAT

CHARLES M. BOUCEK, M.D., PITTSBURGH

Department of Anatomy The School of Medicine University of Pittsburgh and St. John's General Hospital Pittsburgh

AND

ARTHUR D. RENTON, PITTSBURGH

Department of Anatomy The School of Medicine University of Pittsburgh

WITH the advent of the increasing use of sodium amytal in obstetrics and in animal experimentation involving the fetus, the placental transmission of this anesthetic has become a problem of interest. In a parturient woman, two lives are affected and any means used to relieve or abolish the pains of labor must harm neither the mother nor the child. The widespread use of sodium amytal in experimental work, in which observations upon the fetuses are to be made, has necessitated a complete study of the effects of this barbituric compound upon the fetuses of mothers anesthetized with it.

Drabkin, Ravdin, Hirst, and Lapham (1929), working with sodium amytal anesthesia in obstetrics, reported a series of cases in which they found that the babies of mothers kept under sodium amytal anesthesia during parturition were not narcotized when born, nor did they show any other effects of the drug, but cried lustily immediately after birth. In only two instances were the babies slightly asphyxiated. In these cases the asphyxiation was attributed to difficult delivery. In their entire series, the fetal heart rate was found to be unaltered. Robbins, McCallum, Mendenhall, and Zervas (1929) arrived at much the same conclusion after a detailed study of 80 cases. They concluded that there was no danger to the baby in sodium amytal anesthesia. In their series, 3 babies were asphyxiated and 2 were apnoeic when born, while the remainder breathed spontaneously or after slight stimulation. In most of the apnoeic and asphyxiated cases, the labors were long or forceps were applied. The fetal heart rates varied within normal limits, and the size of the dosage bore no relation to the degree of variation.

So far we have been unable to collect any data from experiments and observations of

other investigators working with sodium amytal or from our own to show that there is any danger to the fetus when the mother is anesthetized with this drug. Our experiments with sodium amytal in pregnancy in the white rat, and in the study of the transmission of this crystalloid substance from mother to fetus and from fetus to mother in this animal, have given us further proof that the placenta of the white rat acts as an organ or an organ system which selects and rejects substances that might pass through it. The fact that sodium amytal is readily transmissible from fetus to mother but not from mother to fetus warrants this conclusion.

MATERIALS AND METHODS

White rats (*Mus norvegicus albinus*) were used in these experiments. They were selected from the rat colony of the Department of Anatomy of the University of Pittsburgh.¹ This stock of rats has been under colonization for experimental purposes for the past 7 years. The male animals and non-pregnant females employed as controls for the dosage of sodium amytal were young adult animals. The pregnant females were selected without reference to the age of the animal although, when possible, those having previously given birth to one or more litters were used. For the first group of experiments pregnant animals with relatively large fetuses were used, for the second group, including the control experiments, pregnant animals between the eighteenth and twentieth day of gestation were selected, and for the third group, females between the fifteenth and twentieth day were employed.

A 2 per cent solution of sodium amytal (sodium *iso-amyl ethyl-barbiturate*) was used

¹ We wish to express our appreciation for the helpful suggestions of Doctor Davenport Hooker and Doctor John C. Donaldson of the Department of Anatomy of the School of Medicine University of Pittsburgh.

The solution was prepared according to the method described by Mulinos (1928) from the insoluble crystalline iso amyl ethyl barbituric acid¹. The insoluble acid was suspended in distilled water, 5 cubic centimeters for each gram. The mixture was gently heated in a water bath and frequently shaken during the addition of 15 per cent sodium hydroxide drop by drop, until solution was complete. The solution was then diluted to 10 cubic centimeters for each gram of material used. The resulting solution of sodium amytal (10 per cent) was kept in a glass stoppered bottle as the stock solution. It was subsequently diluted with distilled water to a 2 per cent solution just before using.

A newly prepared solution was always allowed to stand at least 3 days before being used, due to the fact that it causes undue irritation to the animal if injected before that time. This observation has been reported previously by Mulinos (1925). The solution showed a tendency to become cloudy or opalescent after 1 to 6 days. According to Zerfas, McCallum, Shonle, Swanson, Scott and Clowes (1929), this is due to the precipitation of the insoluble acid in fine crystals brought about by the lowering of the hydrogen ion concentration from the limits of 9.8—9.5 to 9.2 or lower. A solution of this type was found to exert a toxic effect upon the respiratory center, as shown by various irregularities in respiration. For this reason, the solution was always filtered before it was used. Stock solutions of 10 per cent sodium amytal can be kept in a tightly stoppered bottle for several weeks without becoming toxic or losing their anesthetic properties (Lieb and Mulinos, 1929).

The optimum dosage required for the production of complete anesthesia was found to be about 80 milligrams per kilogram of body weight. The exact amount necessary was accurately calculated from the weight of the animal. After the initial experiments the estimated weight of the fetuses was deducted from the mother's weight in determining the dosage.

¹ Since the completion of our work Lilly and Company has placed on sale a preparation of sodium amytal which Lieb and Mulinos found to have the same anesthetic properties with no greater toxicity than their own preparations of this substance.

The technique employed in administering sodium amytal to the mothers and in stimulating the fetuses was as follows:

1 The animal was put under light ether anesthesia in order to facilitate weighing and injection of the sodium amytal.

2 The calculated amount of 2 per cent sodium amytal was injected intraperitoneally, a 1 cubic centimeter Luer tuberculin syringe and a 27 gauge needle being used, while the animal was recovering from the ether anesthesia. Care was taken to avoid the uterine horns during injection of the sodium amytal.

3 After the animal had been under complete amytal anesthesia for 10 to 15 minutes, the abdomen was opened. A needle was then inserted diagonally through the uterine wall and fetal membranes, and the fetus stimulated by the prick of the needle. The fetuses were stimulated every 15 minutes during the period of anesthesia of the mother, and their responses observed. This routine was followed for a series of 25 pregnant animals under amytal anesthesia.

In a second series of 25 pregnant animals, the fetuses were again stimulated at 15 minute intervals as above. In addition to this, one fetus was removed every 15 minutes, and tested for reactions by lightly touching the surface of the body with a needle.

The technique employed in the administration of 2 per cent sodium amytal to the fetuses was as follows:

1 The mother was put under light ether anesthesia, weighed, and her fetuses palpated to determine their approximate weight.

2 The amount of amytal to be used was calculated on the basis of the weight of the mother minus the estimated weight of the fetuses.

3 The abdomen was then opened and the uterine horns carefully lifted out of the abdominal cavity.

4 By means of a 1 cubic centimeter Luer tuberculin syringe with a spring attachment and a 27 gauge needle, the calculated amount of 2 per cent sodium amytal was injected into the abdominal cavities of the fetuses. The injection was done very carefully, the needle piercing the walls of the uterus, the fetal membranes, and the abdominal walls of the fetus.

at an oblique angle. The perforations through each of these coverings were staggered, so as to prevent leakage after the needle was withdrawn. The necessary amount was equally divided among all the fetuses.

5 The abdomen of the mother was then closed, during which time the animal was allowed to recover from the ether anesthesia.

6 Observations were then made of the time taken for the sodium amytal to produce partial and complete symptoms of anesthesia in the mother.

7 The animal was autopsied 2 or 3 days later to determine the effect of the injected sodium amytal upon the fetuses.

The technique of injecting 2 per cent sodium amytal into the amnia corresponded closely with that just described for the fetuses, the difference being that the anesthetic was introduced into the amniotic sac instead of into the abdomen of the fetus.

EXPERIMENTS

The experiments may be divided into three main groups: (1) preliminary experiments to determine the anesthetic dose of sodium amytal for a pregnant animal, (2) experiments showing the effect upon the fetuses of anesthesia of the mother with sodium amytal, (3) experiments showing the effects upon the mothers of injections of fetuses with sodium amytal.

The first group of experiments was made necessary by the fact that the calculation of an anesthetic dose of sodium amytal is different in pregnant from that in non-pregnant animals. The second group, concerned with the fetuses of mothers anesthetized with sodium amytal, comprises two series. Series I pertains to the stimulation of fetuses *in utero* of mothers anesthetized with sodium amytal, and Series II concerns the stimulation of fetuses *in utero* followed by the stimulation of the fetuses after their removal from the uterus. The third group is also divided into two series. Series III, the injection of sodium amytal into the abdominal cavity of the fetus, and Series IV, the injection of sodium amytal into the amniotic sac of the fetus, in each case to determine its time of absorption and possible transmission through the placenta.

The first group of experiments may be considered as a preliminary group and a set of experiments that was made necessary due to the fact that when work was first started on this problem about 60 per cent of our pregnant animals received lethal doses of sodium amytal when injected with the usual dosage calculated from the weight of the animal. In these first experiments the pregnant animal was weighed and the amount of sodium amytal necessary to anesthetize it was calculated from the weight of the animal (80 milligrams per kilogram). These animals became completely anesthetized in 2 to 5 minutes and 60 per cent of them died in from 10 to 35 minutes (Table I, Nos 1 to 5). It appeared that either our solution was too strong or our calculated dose was in error. Rechecks of our solutions (Table I, Nos 11 to 16) and further work showed that our results were due to failure to allow for the weight of the fetuses. Evidently these played no part in the absorption of the drug and their weight, when not considered, was sufficient in the majority of cases to cause the dose to be lethal. Each solution of sodium amytal may vary slightly in toxicity and anesthetic properties from day to day and, unless controlled daily, even the excess weight of the fetuses will cause untoward results. From this observation alone, we suspected that the placenta was acting as a barrier to sodium amytal, thus causing our original dose of the anesthetic within the body of the mother to be lethal.

A number of experiments were then made in which the animals were weighed, the estimated weight of the fetuses subtracted from the weight of the pregnant animal, and the amount of sodium amytal necessary to anesthetize it calculated from the approximate weight of the animal minus the weight of the fetuses. In all cases in which this routine was followed, the animal survived (Table I, Nos 6 to 10). In subsequent experiments, the dose of sodium amytal was calculated from the weight of the mother minus the estimated weight of the fetuses.

Before working on the second group of experiments (the effect upon the fetuses of sodium amytal anesthesia of the mothers), controls were made to test fetal susceptibility to

TABLE I

| No | Weight of pregnant animal (grams) | Estimated weight of fetuses (grams) | Estimated weight of mother minus weight of fetuses (grams) | Weight of non-pregnant female or male (grams) | Amount of amytal 40 cc. m. per 1000 gram (40 mgm. per kilo) | Results |
|--------------|-----------------------------------|-------------------------------------|------------------------------------------------------------|-----------------------------------------------|-------------------------------------------------------------|-----------------------------------|
| 1 | 215 | Not taken into consideration | Not taken into consideration | | 0.86 | Died |
| 2 | 470 | Not taken into consideration | Not taken into consideration | | 0.68 | Died |
| 3 | 153 | Not taken into consideration | Not taken into consideration | | 0.64 | Died |
| 4 | 205 | Not taken into consideration | Not taken into consideration | | 0.86 | Anesthesia with complete recovery |
| 5 | 230 | Not taken into consideration | Not taken into consideration | | 0.93 | Anesthesia with complete recovery |
| 6 | 485 | 20 | 465 | | 0.66 | Anesthesia with complete recovery |
| 7 | 318 | 22 | 296 | | 0.82 | Anesthesia with complete recovery |
| 8 | 492 | 18 | 474 | | 0.79 | Anesthesia with complete recovery |
| 9 | 203 | 22 | 181 | | 0.72 | Anesthesia with complete recovery |
| 10 | 205 | 25 | 180 | | 0.80 | Anesthesia with complete recovery |
| 11 (control) | | | | 400 | 0.80 | Anesthesia with complete recovery |
| 12 (control) | | | | 208 | 0.83 | Anesthesia with complete recovery |
| 13 (control) | | | | 170 | 0.68 | Anesthesia with complete recovery |
| 14 (control) | | | | 175 | 0.79 | Anesthesia with complete recovery |
| 15 (control) | | | | 230 | 0.92 | Anesthesia with complete recovery |
| 16 (control) | | | | 170 | 0.68 | Anesthesia with complete recovery |

sodium amytal by injecting small doses directly into the fetuses *in utero*. The procedure was as follows:

1 The mother was put under light ether anesthesia and her abdomen opened.

2 One fetus was removed and its exact weight determined.

3 The dosage of sodium amytal (2 per cent) required for a single fetus was then calculated, using the same basis as that used for adult animals (80 milligrams per kilogram).

4 The remaining fetuses were injected as follows: (a) two fetuses were given one fourth of the calculated amount, (b) two fetuses were given one half of the calculated amount, (c) two fetuses were given the calculated amount, (d) two fetuses were given double the calculated amount, (e) the remaining one to three fetuses were left uninjected.

The fetuses were removed from the uterus after 15 minutes and lightly stimulated by stroking or pricking with a needle. Those injected with one fourth the amount of solution were little affected and responded readily to this stimulation, fetuses injected with one half the amount showed a noticeable decrease in response, when the full amount was given there was no response, and when double the dose was injected, the fetuses were killed. These results indicate that the fetus is susceptible to sodium amytal in about the same degree as, or possibly a little more than, the mother.

With these data available, it was possible to proceed with the experiments in Group II, the aim of which was to determine the effect upon the fetuses of maternal anesthesia with sodium amytal. Pregnant animals were given

TABLE II¹

| Number | Wt. of pregnant animal | Estimated wt. of fetuses | Estimated wt. of amniotic fluid and placenta | Amt. of sodium amytal based on 80 mgm. per kilo | No. of fetuses | Age of fetuses—days | No. of fetuses injected | No. of amniotic sacs injected | First sign of anesthesia in minutes | Complete anesthesia in minutes | Condition of fetuses | Condition of mother |
|--------|------------------------|--------------------------|----------------------------------------------|-------------------------------------------------|----------------|---------------------|-------------------------|-------------------------------|-------------------------------------|-----------------------------------|----------------------|---------------------|
| 1 | 220 | 20 | 200 | 0.80 cc cm | 8 | 15 | 8 | | 3 min | 25 | Dead | Recovery |
| 2 | 225 | 25 | 200 | 0.80 cc cm | 8 | 18 | 8 | | Direct ether to amytal anesthesia | 25 | Dead | Recovery |
| 3 | 205 | 5 | 200 | 0.80 cc cm | 1 | 20 | 2 | | 5 min | 40 | Dead | Recovery |
| 4 | 245 | 35 | 210 | 0.85 cc cm | 11 | 18 | 10 | | Immediately | 25 | Dead | Recovery |
| 5 | 262 | 15 | 150 | 0.60 cc cm | 3 | 20 | 3 | | 3 min | 20 | Dead | Recovery |
| 6 | 225 | 20 | 215 | 0.36 cc cm | 8 | 18 | 3 | | Immediately | 1 | Dead | Recovery |
| 7 | 243 | 15 | 228 | 0.51 cc cm | 6 | 15 | 6 | | 8 min | Never complete anesthesia | Dead | Recovery |
| 8 | 235 | 10 | 215 | 0.90 cc cm | 3 | 20 | 3 | | 10 min | 26 | Dead | Recovery |
| 9 | 251 | 20 | 151 | 0.52 cc cm | 7 | 16 | 6 | | Direct ether to amytal anesthesia | Direct ether to amytal anesthesia | Dead | Recovery |
| 10 | 279 | 24 | 162 | 0.66 cc cm | 8 | 15 | 6 | | 2 min | 4 | Dead | Recovery |
| 11 | 220 | 25 | 195 | 0.78 cc cm | 8 | 18 | 6 | | 5 min | 12 | Dead | Recovery |

¹The injection of sodium amytal into the fetuses and amniotic sacs of fetuses to determine the absorption permeability of the placenta to sodium amytal when injected into fetuses and amniotic sacs of fetuses

a light ether anesthesia, and the calculated amount of sodium amytal was injected into the peritoneal cavity of the mother, care being taken to avoid the pregnant uterine horns. At 15 or 30 minute intervals, during the period the mother remained under the anesthetic, the fetuses in the first series of 25 pregnant animals were stimulated *in utero* with a hypodermic needle, which was inserted diagonally through the uterine wall and fetal membranes. In all instances the fetuses responded and, in most cases, violently, even to the slightest stimulation. Care was taken to use only fetuses between the ages of 18 and 20 days of gestation, since Angulo (1929) stated that fetuses of the fourteenth day after insemination, or earlier, are non-motile, motility and response to stimulation beginning about the fifteenth day. He further concluded that, at about 19 days, the fetuses are roughly comparable in motility to newborn rats and are capable of discrete reflexes.

In the second series of 25 pregnant animals, the fetuses were stimulated at 15 minute intervals and, in addition, a fetus was removed every 15 minutes during the time the mother remained under the sodium amytal. The umbilical cord was tied and cut, and the fetus

examined and tested with light strokes of a needle for movements or reactions. In all cases, they responded to this stimulation. When the fetuses were delivered from the uterine cavity and the umbilical cord tied and cut, they often became very active and gasped for air, thus showing that they could not be under the effects of the anesthetic.

The conclusion drawn from the entire second group of experiments is that the crystalloid substance, sodium amytal, does not pass the placenta from mother to fetus in large enough quantities to be detected by these gross experimental methods.

The third group of experiments, which was performed to determine the transmission of sodium amytal from fetus to mother and the time of its absorption and transmission, was divided into two series. In Series III, pregnant animals were weighed, the weight of the fetuses estimated and subtracted from the weight of the mother, and the amount of sodium amytal necessary for complete anesthesia of the mother calculated from the corrected weight. This dose was then injected into the abdominal cavities of the fetuses, the amount being equally divided among them. In Series IV the same routine was followed

as for the third, except that the sodium amytal was injected into the amniotic sac instead of into the abdominal cavity of the fetus. The results of these experiments are shown in Table II.

The chief aim of this group of experiments was to determine whether or not sodium amytal passed through the placental barrier from fetus to mother. It can be seen from Table II that, in all cases when sodium amytal was injected into the abdominal cavity of the fetus or into the amniotic sac, the anesthetic readily passed through the placental barrier from fetus to mother, causing complete anesthesia of the mother within a short time. In all cases, just sufficient sodium amytal was injected into the fetuses or amniotic sac to produce complete anesthesia of the mother. Therefore, the greatest part, if not all, of the sodium amytal, must have been eliminated by the fetus and passed through the placenta. Further support for this conclusion was obtained from the results of control experiments carried out to determine the effect upon the mother when the fetuses were injected with a dose calculated as lethal for the adult rat.

The procedure was as follows: (1) The mother was put under ether anesthesia. (2) The abdomen was opened and the uterus exposed. (3) The fetuses were then injected with a dose calculated as lethal for the mother (150 milligrams per kilogram) as reported by Drabkin, Ravdin, Hirst, and Lapham (1929). (4) The uterus was replaced in the abdominal cavity, the latter was closed and ether anesthesia was discontinued.

The following results were noted:

1. In all cases, the mother passed directly from ether into sodium amytal anesthesia.

2. Death resulted in 5 minutes to $1\frac{1}{2}$ hour in 75 per cent of the cases.

Therefore, the conclusion that sodium amytal is practically entirely eliminated by the fetuses and passed through the placenta into the mother receives further substantiation from these results.

The third group of experiments demonstrates that sodium amytal is absorbed both from the abdominal cavity and from the amniotic sac of the fetus with relative rapidity and, perhaps *in toto*, passed through the pla-

centa to cause complete anesthesia of the mother.

DISCUSSION

These experiments show that in the white rat sodium amytal passes through the placenta more readily in one direction than in the other. This substance passes with difficulty and perhaps not at all from mother to fetus, yet readily passes from fetus to mother. The conclusion that sodium amytal does not pass in quantity from mother to fetus is based upon two experimental facts: (1) the dose of sodium amytal calculated from the total weight of the pregnant animal proved lethal for the mother in 60 per cent of cases, but doses calculated from the weight of the mother minus the estimated weight of the fetuses were never lethal, and (2) the fact that fetuses of pregnant animals, under amytal anesthesia, showed no signs of being anesthetized or in any way affected by sodium amytal. No chemical analysis was made of the sodium amytal content of the blood of the fetuses of mothers under this anesthetic. No proof can be offered, therefore, that it does not pass in minute quantities. However, our experiments proved that it does not pass in large enough quantities to affect the fetus sufficiently to be detected by observation or by stimulation methods. This leads us to believe that sodium amytal in doses just sufficient to anesthetize the mother, does not pass from the mother to the fetus.

On the other hand, when sodium amytal was injected into the fetuses or into the amnia, it readily passed the placental barrier and in a short time caused complete anesthesia of the mother. The dose injected into the fetuses, or amniotic sacs, was just sufficient to cause complete anesthesia of the mother, therefore, the greatest part, if not all, of the anesthetic must have passed from the fetus to the mother. This conclusion was further substantiated by the fact that when the fetuses were injected with a dose calculated as lethal for the mother, the latter died after a few minutes in 75 per cent of the cases.

These experiments add further evidence in favor of the conclusion drawn by Boucek (1928) that the placenta behaves as an organ or organ system which selects and rejects cer-

tain materials Schlect (1907) concluded from his work on vitally stained chorionic cells that the chief function of these cells is to protect the fetus from toxic substances in the maternal blood stream. It is our opinion that the cells of the placenta are selective in character and that there is a mechanism, as yet unknown, which not only prevents harmful products from entering the fetus but reacts quickly to transfer harmful products from fetus to mother.

It is of interest to note the time of transmission of sodium amytal from the fetal tissue to that of the mother. When the solution was injected into several fetuses or amnia, the mothers often became anesthetized almost, or quite, as quickly as did animals in which this anesthetic was injected directly into the peritoneal cavity. The time that elapses before the mother becomes anesthetized seems to vary with several factors. The most important appears to be the particular solution of sodium amytal used, since each solution differs somewhat in its anesthetic properties. The age of the fetuses is another possible factor, but the present experiments do not warrant any conclusions as to its influence. The number of fetuses injected plays an important rôle. In one case, in which one fetus only was injected, the mother showed the first signs of anesthesia in 5 minutes and was completely anesthetized in 40 minutes (Table II, No. 3), which is about three times as slow as the rate obtained when the solution was injected directly into the peritoneal cavity of the mother. When a number of fetuses or amnia were injected, the time of anesthesia of the mother diminished and, not infrequently, anesthesia occurred as quickly as when the solution was placed in her abdominal cavity (Table II). It may be said that within certain rather indefinite limits, the time required for complete anesthesia of the mother varies inversely with the number of fetuses or amnia injected, the age of fetus, and the particular solution used.

The question regarding the difference in the time of absorption and transmission of amytal injected into the fetuses and into the amniotic sacs was considered. However, due to the fact of the variation in anesthetic properties of

different solutions of sodium amytal, we did not standardize our methods by injecting the same number of fetuses or amniotic sacs at the same age. Therefore, these experiments present insufficient data from which to draw definite conclusions concerning this question. At the present time, we are working on this phase of the problem, using dye solutions which have a more uniform composition, and we find, as we have suspected from observations on animals injected with sodium amytal, that the absorption and transmission of solutions from the amniotic sac is slower than from the fetal tissues.

One observation, not concerned directly with this problem but with sodium amytal anesthesia in general, has come to our attention several times during our work with this anesthetic. We have noticed that the calculated dose of amytal did not always cause complete anesthesia of the animal. In such cases the animals, when undisturbed, appeared to be completely anesthetized. When operative procedures were begun, however, they became restless and attempted resistance. If these animals were given a few whiffs of ether, they became completely anesthetized and remained under sodium amytal anesthesia for the usual length of time without further use of ether. Mason and Baker (1930), working with sodium amytal on man, have reported similar observations. They state that this anesthetic gives the best results when supplemented with others, either general or local.

CONCLUSIONS

- 1 The amount of sodium amytal necessary to anesthetize a pregnant rat does not in any way interfere with the viability of the fetus, the fetus is not anesthetized and readily responds to gross stimulation.

- 2 Sodium amytal quickly passes from the fetal circulation into the maternal circulation.

- 3 In calculating the amount of sodium amytal necessary to anesthetize a pregnant animal, the weight of the fetuses must be subtracted from the weight of the mother.

- 4 The anesthetic value of sodium amytal may be enhanced when supplemented with small quantities of ether.

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CLINICAL SURGERY

FROM THE GRADUATE SCHOOL OF MEDICINE, UNIVERSITY OF PENNSYLVANIA

OPERATIVE TREATMENT OF LOSSES OF SUBSTANCE OF THE MANDIBLE, WITH SPECIAL REFERENCE TO FIXATION OF EDENTULOUS FRAGMENTS

ROBERT H. ILLI, MD. DDS. F.A.C.S., AND LAWRENCE CUKTIS, AB, MD. DDS. PHILADELPHIA

PERMANENT loss of substance of the mandible may be the result of trauma (comminuted fracture from gunshot wound or other injury), osteomyelitis and necrosis or surgical removal of a part of the bone on account of a tumor or other pathological condition. This loss of substance, after arrest of disease and healing of the soft tissues have taken place, causes a more or less marked disability, according to the location and extent of the defect, the presence of adhesions, and the number of teeth missing. Where the bone loss involves the lateral portion of the mandible, the fragment on the sound side is drawn over toward the defect so that the teeth lie too far within those of the upper jaw. In most cases this main mandibular fragment is bound over to the smaller fragment by scar tissues so that complete reduction to normal position by manipulation is generally impossible. Occasionally, however, mobility is quite free, and the normal space between the fragments can be easily obtained by manipulation. The resulting malocclusion of the teeth and instability of the fragments renders the mastication of solid food difficult or impossible. In addition, marked external deformity is noted. The chin deviates to the affected side, and there may be a concavity in the cheek on this side due to upward and inward displacement of the small bone fragment behind the defect.

If the loss of substance is at the symphysis of the mandible, the normal horseshoe shape of the bone will be converted into a V. The contracture in front will cause a bilateral drawing in of the lower teeth, so that they will bite far within those of the upper jaw. Here again we note a crippling of the mastication and a narrowing of the lower part of the face.

In the preliminary treatment of these defects prior to bone grafting to restore the bone loss, if

there are several sound teeth in each fragment the problem of fixation in normal position by means of wires or splints to the upper teeth is comparatively simple. But the absence of teeth in either or both mandibular fragments or in the upper jaw greatly complicates the treatment of these deformities.

The condition which we particularly wish to discuss here, is a healed unilateral defect of the premolar and molar region of the mandible with a loss of about one and a half inches of bone, with several sound teeth in the large fragment and the upper jaw, but none in the smaller mandibular fragment posterior to the defect. As a consequence of the absence of teeth to oppose those of the upper jaw, the anterior end of this small fragment is pulled upward by the levator muscles attached to it, so that its lower border, instead of being horizontal, points forward and upward at a marked angle, and the gum covering its upper border meets the teeth of the upper jaw (Fig. 1). The anterior end of this fragment may also be drawn toward the median line, producing a concavity in the side of the face. Many more or less complicated schemes have been devised for keeping this posterior edentulous fragment down in position. One plan that has frequently been tried is the use of a metal or vulcanite saddle splint resting on the soft tissues over the edentulous fragment and attached in front by caps to the teeth of the larger mandibular fragment. It has been found that the pressure exerted by these saddles often causes irritation, pain, ulceration, and even sloughing of the soft tissues covering the bone. Others have used a sharp forked metal extension which punctures the gum and penetrates the bone superficially. This appliance is difficult to construct, and the penetration of the bone and soft tissues from the mouth frequently leads to infection. The nail

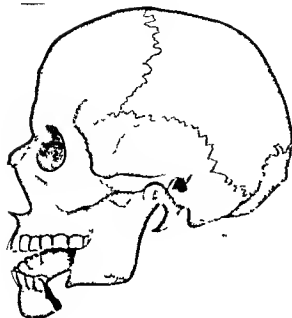


Fig. 1 Diagram of lateral mandibular defect showing displacement of fragments

extension principle has been applied to these cases by Lindemann (1). The angle of the mandible is exposed through a small skin incision a hole is drilled through the bone and a special bolt passed through the hole and fastened with a nut. The end of the bolt extends out through the skin incision. Control of the bone fragment is thus achieved by making traction on the bolt in a backward and downward direction by an elastic band whose other end is connected with a plaster of Paris head cap or with a bar running backward outside the cheek from a cup splint on the teeth. These methods are all complicated and require highly specialized dental technique. What is needed for these cases is a simple but efficient method of control easily applicable by the surgeon at the time of operation without previous elaborate dental technique. Darcissac (6), in a case of double fracture of the mandible posterior to the last tooth on each side, to hold down the short posterior fragments drilled a hole through each angle, passed a silver wire through the hole in the bone, bringing the ends out through the skin incision. Backward and downward traction on the posterior fragments was made by connecting the two wires with a heavy elastic band around the back of the neck. We employ a similar simple application of the nail extension principle in controlling the edentulous posterior fragment in the mandibular defects under consideration.



Fig. 2 Exposure of angle of mandible through skin incision

The treatment of this type of case divides it self into two principal stages (1) preliminary reduction and fixation of the fragments in normal position (2) restoration of the continuity of the mandible by bone graft.

Preliminary reduction and fixation of the fragments in normal position. Before anesthetizing the patient for the operative procedure, a plaster of Paris cap must be made for the head to provide a means of fixation for the edentulous fragment of the mandible. In this we follow the technique of Scoggin (7), whereby a comfortable and firm head cap is produced. The materials required are (1) stockinette 3 inches wide by 2 feet long, (2) narrow gauze bandage 1 foot long, (3) adhesive plaster 1 inch wide, (4) orthopedic felt, 4 strips $1\frac{1}{2}$ inches wide and 6 inches long, (5) plaster of Paris bandage, $2\frac{1}{2}$ inches wide, (6) heavy iron wire, such as an ordinary wire coat hanger.

Construction steps. (1) The patient is seated in a chair and draped with a sheet, (2) in men if the case is to require lengthy fixation, the hair is clipped—otherwise not necessary. Women are requested to braid the hair and arrange it in a loose coil at the top of the head. (3) one end of the stockinette is applied over the head to a point 2 inches below the border of the finished cast. (4) a gauze bandage is tied loosely around the stockinette at the top of the head, (5) felt strips are cut and adjusted one in each quadrant of the head, and are fastened in place on the stockinette, with adhesive plaster, (6) the free end of the stockinette is pulled down over the head and trimmed just short of the first layer. Felt strips are now between the layers of the stockinette, (7) a wet plaster of Paris bandage is applied over the stockinette, and is smoothed into place, (8) the edges of both layers of stockinette are turned up to form the lower border of the cap, and are plastered smoothly into bandage,

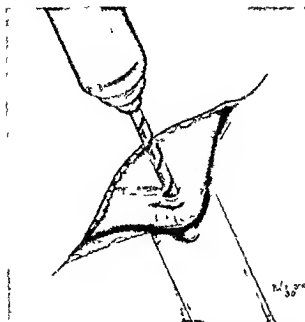


Fig 3 Hole being drilled through mandible near angle

(9) a piece of iron coat hanger wire is bent to fit the side of the head against the plaster bandage, the hooked end being allowed to project downward behind the ear on the side of the jaw fragment to be controlled, (10) a second plaster bandage is applied, it being worked well around and over the wire to hold it firmly in place. The lower half inch of stockinette is left exposed below bandage to produce a smooth rounded border. The finished head cap is shown in Figure 5. Provision for fixation of the larger mandibular fragment is now made by application of two or three pairs of brass eyelet wires to the lower and corresponding upper teeth. Each pair of upper and lower eyelets is connected by a third wire, holding the teeth in occlusion. The method has been described many times (2, 3). If a sufficient number of sound teeth are present in both jaws, this method gives adequate fixation, and is very much simpler than the use of special splints. In case the teeth are not sufficient in number and stability for direct application of eyelet wires, we employ arches made of half-round German silver wire. A piece of this is molded to conform to the vestibular surfaces of the lower teeth and attached to these with 24 gauge brass wire ligatures. A similar arch is applied to the upper teeth and the upper and lower arches are fastened together with the brass ligature wires. If desirable or necessary, the attachments can be made to the teeth at this time, and the connecting of the upper and lower teeth postponed until after operative reduction. However, if reduction of the main fragment and restoration of occlusion of the teeth is possible be-

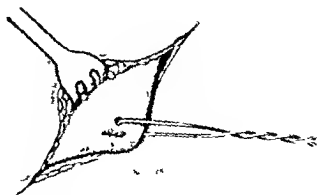


Fig 4 Brass wire passed through hole at angle of mandible

fore operation, there is no objection to fastening the teeth together immediately. We have never seen any difficulty from general anesthesia in these cases where the teeth are fastened together.

The patient is now etherized by intraoral or intrapharyngeal vaporization. The first step of the operation is free mobilization of the larger fragment so that the teeth can be easily brought into occlusion with those of the upper jaw. To bring this about it may be necessary to cut bands of scar tissue within the mouth between the two fragments. The upper and lower teeth are then fastened firmly in occlusion. This enables the operator to judge better the amount of reduction necessary to bring the posterior edentulous fragment into position. After working in the mouth, the surgeon should put on fresh gloves before proceeding with the extraoral part of the operation. An oblique skin incision, slightly convex downward, about 3 centimeters in length, is made at the angle of the mandible. The deeper tissues are divided or pushed away by blunt dissection to expose the bone at the angle both externally and internally over an area of about 2 centimeters in diameter (Fig 2). A broad, thin elevator is passed beneath the angle to raise and support it while a small hole is drilled through it. The hole is drilled at a point about 1.5 centimeters from the edge of the bone (Fig 3). Two strands of No. 24 gauge soft brass wire 12 inches long are twisted together. This double strand is then passed through the hole in the angle of the mandible (Fig 4). With this wire, downward and backward traction is made on the bone. If the bone fragment does not come into proper position it must be thoroughly freed from scar tissue connections by scissors inserted in the incision. Perforation into the mouth through the mucous



Fig. 5 Wire from angle of mandible connected with hook on plaster of Paris head cap by elastic band making traction on edentulous posterior fragment

membrane should be avoided if possible, because if it occurs a longer time is required for healing and infection may take place along the wire. However, it is essential at all costs to free thoroughly the mandibular fragment at this time so that complete reduction is possible by downward and backward traction on the wire. The ends of the wire are twisted together outside the wound and connected to the hook on the plaster head cap either directly or by means of a heavy elastic



Fig. 7 Plaster cap and traction wire from posterior fragment



Fig. 6 Roentgenogram showing comminuted gunshot fracture of left side of mandible

band (Fig. 5). The tension on the wire must be sufficient to keep the edentulous mandibular fragment down in position. The wound is closed with a few interrupted dermal sutures, without drainage, the wire emerging through its posterior end. It is covered with a small gauze dressing attached with adhesive plaster. Very little postoperative reaction occurs as a rule, especially if the oral mucous membrane has not been opened. The sutures are removed on the fifth day. By these procedures the two mandibular fragments are reduced and fixed in their normal positions, and the space between them corresponds in length to the lost portion of bone. It is now necessary to wait for a period of 2 to 8 weeks until healing of the soft tissues takes place; that is, until the ends of the bone fragments are safely sealed off from the mouth cavity and from external wound infection. The head apparatus and wires on the teeth remain in place during this time. The patient is fed on liquids through a tube. In many cases where teeth are missing semisolid and mashed foods can be taken.

Filling the mandibular defect by a bone graft. As soon as it is considered that the ends of the mandibular fragments are safe from infection from the foregoing operative procedure (2 to 8 weeks), the bone grafting operation to restore continuity is undertaken. In previous articles (4, 5) we have set forth the advantages of the crest of the ilium as a source of the mandibular bone graft. The crest of the ilium furnishes a large piece of bone, of porous structure, closely allied to that of the mandible, is easily penetrated



Fig 8 Roentgenogram showing traction wire holding posterior fragment in position also extent of mandibular defect

by new vascular supply, and can be readily cut to suitable shape. The disability produced by removal of the graft is quite temporary and the danger negligible. These points favor it over the usual thick graft from the tibia, which is dense, not easily penetrated by new vascular supply, is brittle and hard to trim to the desired shape, and its removal may be followed by fracture of the leg unless extreme postoperative care is used. In these defects of the lower jaw, there is no necessity for strength and rigidity of the graft itself, because the fragments are already held firmly by the fixation apparatus and there need be no dependence on the graft for immobilization.

The patient is etherized without disturbing the fixation apparatus on the bone fragments. The first step is exposure and preparation of the ends of the mandibular fragments. This is done before the graft is removed from the ilium in order that the size of graft required may be determined and also on account of the possibility of opening into the mouth while preparing the mandibular site—an accident which would render useless the graft at this time. A skin incision with convexity downward is made over the bony defect, and the skin flap is turned upward. A second flap, consisting of deeper tissues, is then turned up. Extreme care is taken to avoid opening into the buccal cavity. Scar tissue between the fragments is carefully removed and the ends of the bone are thoroughly exposed and beveled slightly to create broad freshened surfaces. A hole is drilled in the end of each fragment for the passage of a No. 24 gauge brass wire. Bleeding is arrested. The length of the gap is measured with a probe.

An incision is made along the crest of the ilium of the same side as the jaw defect, down to the

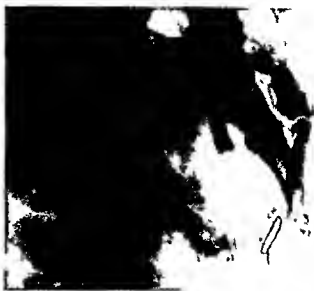


Fig 9 Roentgenogram showing bone graft from crest of ilium filling defect of mandible

periosteum, beginning at the anterior superior spine back as far as necessary. The muscles attached to the outer and inner lips of the crest are stripped down, and a piece of bone is removed with a metacarpal saw, beginning at the anterior superior spine and working backward. The graft comprises the full width of the crest of the ilium and should be of sufficient length and depth to fill the gap in the mandible, allowance being made for slightly overlapping the mandibular fragments at each end. The detached muscles are brought over the site of removal of the graft and sutured together with chromicized catgut, the skin of the iliac wound is closed with dermal sutures. A small rubber tissue drain may be inserted for 24 hours.



Fig. 10 Patient after restoration of continuity of mandible showing extent of mouth opening and no lateral deviation of lower jaw

Any shreds of muscle are removed from the graft, but periosteum is allowed to remain. The ends are slightly beveled and holes drilled in them. The wires attached to the mandibular fragments are then passed through the holes and twisted so that the graft fits snugly in contact with the mandibular fragments. We prefer wire bone sutures to catgut or kangaroo tendon because a very much firmer contact between the bones can be obtained. The ends of the wires are cut off short and turned over so that they will not project into the soft tissues. The wires usually remain permanently without causing irritation, but they can easily be removed later if desired. The liver of deeper soft tissues is sutured with catgut to cover the bone and the skin flap is closed with interrupted dermal sutures, usually without drainage.

Postoperative treatment. The wire fixation on the teeth is kept in place for about 12 weeks after the graft operation. It is generally not necessary to retain the traction on the posterior fragment for this length of time. Usually about 4 weeks after the operation the head cap and the traction wire can be removed. After 8 weeks the upper and lower teeth can be unlocked at intervals to permit gentle exercise and to stimulate bone consolidation. Union should be firm in about 3 months, after which it is usually possible to have the missing teeth replaced by an artificial denture.

The following is a brief description of a case illustrating the application of these principles.

H. H. male aged 32 years chauffeur was shot with a large caliber pistol in August 1930 the bullet entering the left side of the face shattering the left side of the mandible and remaining imbedded in the tissues (Fig. 6). An operation was performed at that time for removal of detached teeth bone fragments and bullet. In October an open

bite metal dental splint with saddle resting on the gum over the posterior edentulous fragment was inserted. By January 1930 suppuration had ceased and the tissues had healed. The patient was referred to us by Dr. F. C. Bartleman of Newark, New Jersey on March 27, 1930 for further treatment. At this time a gap of about 1 1/4 inches was found on the left side of the mandible. This defect extended from just posterior to the left central incisor tooth to about the second molar region. There were no teeth in the bone fragment posterior to the defect. Only four teeth were present in the main mandibular fragment. The metal splint was still in position and the saddle resting on the gum kept the short posterior fragment down in place but there was ulceration of the soft tissues from undue pressure. On removal of the splint the main mandibular fragment was found to be freely movable and showed a tendency to swing over to the left side throwing the teeth out of occlusion and causing marked external deformity (Fig. 7). The metal splint was discarded and the remaining lower teeth were brought into correct occlusion with the upper teeth and fastened by means of wire arches. The short posterior fragment was prevented from tilting upward by wire passed through the left angle and connected to a plaster of Paris head cap (Fig. 8). May 16, 1930 the gap in the mandible was filled by a bone graft from the crest of the ilium. June 20, 1930 the head cap and traction wire were removed. September 8, 1930 the wires connecting the teeth were cut and bone consolidation was practically complete (Fig. 9). The patient could open the mouth without any lateral deviation of the mandible (Fig. 10).

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FROM SURGICAL CLINIC, WASHINGTON UNIVERSITY MEDICAL SCHOOL

A CONCEPT OF THYROIDECTOMY TECHNIQUE OF TODAY¹

WILLARD BARTLETT, M.D., F.A.C.S. AND WILLARD BARTLETT, JR., M.D. ST. LOUIS

IT should be the aim of the surgeon, in operating on a patient with goiter, to do just as much as the patient can withstand at one time. In his estimation of the risk involved by whatever procedure, ranging from merely transporting the patient to the operating room to complete subtotal thyroidectomy, lies the outcome of the case. If the surgeon underestimates the risk, the patient dies, if he overestimates it, the patient suffers the added pain and expense of having the operation unnecessarily divided into stages. Goiter patients do not die as often as they are killed, to put it plainly. However greatly he has increased his risk by delay in coming to the surgeon, the fact remains that the goiter patient who dies after operation is dead because too much surgery has been performed, regardless of what it was or why it was done. Since patients vary so widely in the picture they present and there is a corresponding variation in response to preparatory treatment, one must individualize by drawing on a variety of operative procedures and doing that one best adapted to the particular situation.

The choice of operation to be done is dictated with a view of the natural course of thyrotoxicosis. Our own patients rarely come to us in a relative remission of the disease. They come to us on the "down grade," frequently only when they simply cannot carry on any longer. Where the surgeon errs most frequently in choosing to do too much to a seriously depleted patient is in losing sight of this fact. He forgets that the patient will probably get on the upgrade again if not operated on after the usual preparatory treatment at complete rest. He may increase his error by assuming that the goiter must be entirely removed during one hospital stay, whereas the occurrence of a relative remission, when operation becomes safest, may be made more certain and even hastened by ligations in the very sick followed by a wait of 3 to 6 months.

It is our purpose here merely to outline the technique of those operations, other than subtotal thyroidectomy, which we find useful together with a brief mention of indications for their use, reserving detailed discussion for the subtotal or one stage operation. Ligation is reserved for those patients, usually elderly, who

clearly cannot be put in shape for even partial removal of the gland at the first hospital stay by reason of extreme emaciation or cardiac decompensation requiring digitalis for its control. Because the disease has usually been of long standing, subsequent remission can be hoped for only after a period of months during which they neither need, nor can they afford, hospitalization following ligation. Certain patients in young middle life will occasionally be seen in whom the pulse rate remains rapid, above 120, and the pulse pressure wide over a period of weeks of complete bed rest, though the basal metabolism may not remain high. They are "unknown quantities"; ligation is justified on them. We ligate only one side at a time, one ligation offers quite enough hazard to such patients. We have learned through bitter experience that because a patient has withstood any given operation it cannot be assumed that he will again withstand it on the following day or one week later. (So slight a procedure as ligation proved fatal August 30, 1930, to Mrs. McC. 5 days after she had passed through a first ligation with very little reaction.) We have not sufficiently realized that any operation may use up almost all of that mysterious quality, reserve, for an indefinite time. Accordingly, we completely evaluate our patient again before doing the second ligation. *This holds true for any division of thyroidectomy into whatever stages seem best.* It should hardly be necessary to reiterate that there is no "emergency surgery" in thyrotoxicosis, ligation has no place in the treatment of a dying patient. The patient who needs successive ligations is rarely in good enough nutritional or cardiovascular condition to withstand further attack directly on the goiter during that hospital stay. The maximum improvement ensues over a period of from 3 to 6 months. It is highly important to insist on further hospitalization and operation when the rate of improvement falls off, lest one delay too long and the patient once more gets on the down grade.

Our preliminary medication is the same for ligation as for all other operations on the gland, i.e., a dose of one of the barbiturates, either by mouth, intravenously, or per rectum calculated in knowledge of the patient's metabolism, weight,

¹Read by the senior author before the Medical Society of the Missouri Valley Des Moines October 16, 1930.

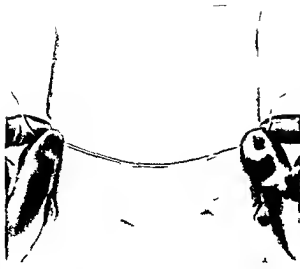


Fig. 1 The ultimate scar will be hidden by a fine chain

and age, a tolerance test having been carried out previously. The dose is sufficient only to produce the state of semi-anæsthesia, on which we have written elsewhere no morphine is given but the patient receives a hypodermic injection of atropine before operation. Nitrous oxid inhalation is employed as the final anæsthetic agent.

We locate the line of incision by searching for the slight depression that can be felt and usually seen between the apex of the pole and the lateral border of the larynx. The incision of which the inner third lies over the larynx and the outer two-thirds over the thyroid tissue is made laterally and slightly upward in a skin fold, if possible. It need not be over an inch in length; it is continued down through the platysma. The upper and lower borders of the incision are then retracted vertically and the deep fascia and ribbon muscles split longitudinally and retracted until the surface of the upper pole is recognized as it ascends and descends with swallowing. The pole is grasped with a hæmostat and lifted toward the operator into the clearly defined groove between the pole and the larynx; a curved Kocher ligature carrier is inserted pointing laterally and slightly upward and gently passed behind the pole until its tip can be seen against the layer of deep fascia at the lateral and posterior border. This tissue is split, freeing the tip of the Kocher, a ligature of extra hard catgut inserted and the Kocher withdrawn. The double strand of catgut is tied traction on the pole is released, and closure of the incision completed by one suture through the cervical fascia, two in the platysma,

and two skin sutures. By this method one has tied the entire upper pole, including the vessels, nerves and lymphatics. There are ordinarily no bleeding points to be tied as the operation is one carried out largely by blunt dissection. The complete procedure takes from 5 to 10 minutes.

There is a group of patients that, on preparatory treatment does not get into entirely satisfactory condition for subtotal thyroidectomy, particularly if the latter operation promises to be extensive because of a large gland. These are regarded as uncertain risks in which one could not afford to have anything go wrong at operation in which a bad "break" might seriously encroach on the margin of safety. In such cases we divide the operation, not into two lobectomies but into two stages, the first of which is performed as follows:

The usual exposure of the goiter is carried out through a marked collar incision of skin and fat, longitudinal division of cervical fascia and splitting of ribbon muscles, the fascia is then cross cut for about 3 centimeters to each side of the midline at the level of the upper poles. The sternothyroid muscle is cross divided and allowed to retract. All bleeding points which have been caught are carefully ligated, the four points of the cervical fascia formed by longitudinal and cross division are caught in one continuous suture, the fat pad is approximated with a few interrupted sutures, and the skin incision completely closed.

After a week, subtotal thyroidectomy may be carried out, if the preliminary estimation of the patient has been correct, through a field rendered bloodless by the former operation and therefore in far shorter time than would otherwise be the case. The catgut sutures are soft enough after this interval so that one can separate the layers previously dissected and begin the actual resection of the gland within a few seconds of the start of operation. In final closure, there is almost nothing to ligate except the vessels in the thyroid itself. This flap cutting operation will sometimes allow one to do a subtotal thyroidectomy on a patient a week after he could clearly have withstood only single lobectomy and with a better scar than results from lobectomies a week or ten days apart. However we are gradually coming to the view that the patient on whom lobectomy only is indicated because of poor general condition should not have more than one lobectomy performed during that hospital stay since the first operation draws so heavily on his reserve. Two patients within the past year come to mind who simply wilted and died when second lobectomies were performed a

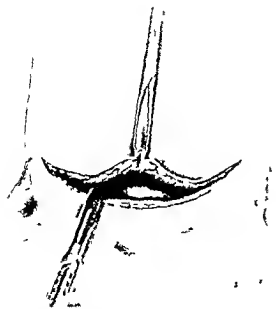


Fig. 2 Full thickness fat flaps mean satisfactory wound closure

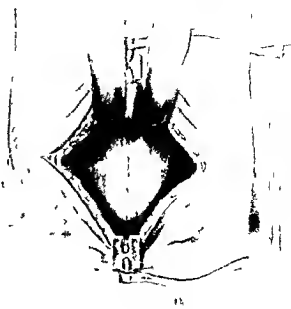


Fig. 3 Position of larynx determines site of mid ribbon cleft

week after primary lobectomies had been accomplished with practically no upset. The "flap cutting" should be reserved for those who are nearly good enough for subtotal thyroidectomy, but in whom a very large goiter and big, pulsating, superficial veins promise such technical difficulties that, should a slip occur, it would greatly endanger the patient. The "flap cutting" seems to take very little out of the patient since it lasts only a few minutes, the gland itself is not manipulated, and a minimum of inhalation anesthetic is required, relaxation being unimportant. It becomes difficult to do subtotal operation if as much as 10 days elapse, however, due to the organization of adhesions. One week is the ideal interval. There occurs in our practice a very considerable group of patients past middle age who have not deteriorated to the point that preliminary ligation only is considered, but on whom subtotal thyroidectomy would throw a burden poorly tolerated. Cosmetic considerations are here entirely secondary, it is important that operation be done quickly and that the period of confinement to bed be short. These requirements are ideally met by dividing the operation into two lobectomies done at different periods of hospitalization with an interval of about 3 months intervening. This greatly lessens the risk in working on a person of over, say, 55 years whose cardiovascular-renal situation is made more uncertain by thyrotoxicosis. We are constantly finding new evidence that as little surgery as possible should be done at a time to one past middle life.

Lobectomy is performed in such cases by making the skin incision over the body of the sternomastoid muscle, splitting that muscle through as much of its length as necessary. But little bleeding is encountered and one comes onto the lobe in an unbelievably short time, with excellent exposure. The lobe and part of the isthmus, if desired, are resected in the routine manner, bleeding points are ligated, a Penrose drain is laid over the gland stump with its ends projecting at the upper and lower extremities of the incision, and a single mattress suture of silk is passed through the skin and cervical fascia, drawing them fairly snugly together over the center of the drain. The ultimate scar is astonishingly good and after a year resembles only a fine wrinkle. The natural tendency of the wound edges is to draw together, since the incision is a muscle splitting one. Moreover, only a small portion of the incision extends above the collar of a man, whereas women in the age group in which this operation is usually found desirable are so thoroughly reconciled to wrinkles as they ever will be. We should hesitate very much to follow this technique on a young woman, frankly, no matter how well resigned to such scars the patient may be, her friends form a very different opinion and decide that they will go to a surgeon who makes nice collar incisions that can be hidden by a string of beads. But for results, no other method we know of getting out one lobe in the shortest time and with the least trauma can compare with it. It is beautifully adapted to large glands and to subclavicular lobes, since it

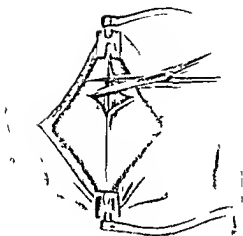


Fig 4 Adequate exposure without sternohyoid muscle division

facilitates freeing the upper pole and "skidding" the lobe up into the neck. The opposite side the site of subsequent operation is not opened, thus making the second operation quite as easy as the first.

We realize that the subdivision of patients into groups suitable for the various operations so far described has been somewhat indefinite. Only careful individual estimation of each patient permits one to be dogmatic as to what method of approach is preferable. We have indicated somewhat sketchily that (a) the seriously depleted thyrotoxic wreck, with generalized parenchymatous damage often added to the degeneration of advanced years is fit only for ligations, followed by a period of restoration before being considered as a possibility for direct attack on the gland; (b) the patient who lacks a little of being a safe risk for subtotal thyroidectomy, particularly because of anticipated technical difficulties can have the thyroidectomy itself much simplified by a preliminary flap cutting with an interval of about a week; (c) the patient, especially a man but also a woman of advanced years, who is "too good for ligation" but highly uncertain for subtotal thyroidectomy is more easily and safely handled by single lobectomies through lateral, muscle splitting incisions at different periods of hospitalization about 3 to 6 months apart.

We now come to the patient who is an acceptable risk for subtotal thyroidectomy. The line of skin incision is marked by the pressure of a strand of silkworm gut held between the thumb and index finger of both hands (Fig 1), the

thumbs resting on the clavicles. This puts the incision just at the level at which a string of beads will rest. The mark made by the gut remains as a line of pallor clearly visible for about five minutes against the familiar flush of the thyrotoxic patient's skin. It provides a guide along which the skin incision is made with an accuracy that cannot otherwise be approximated. The incision is carried down through the full thickness of the fat pad, and on the exactness with which this and the succeeding step are carried out depends to a large extent the cosmetic result; the smooth contour of the female neck is due to this pad of subcutaneous fat beneath which lies the platysma. The edge of the upper flap of the incision is lifted by an Allis forceps (Fig 2) which is carefully placed to grasp its full thickness, that the entire fat pad may be dissected away, with the skin, from the platysma. The lower flap is similarly dissected but only for 2 or 3 centimeters from the line of incision. By leaving the platysma attached to the deep layers, we avoid cross division of the large veins lying beneath it. The upper and lower flaps are now lifted and automatic retractors separate them vertically, thus exposing the deeper layers covered by platysma. The next step is the exact location of the larynx; this is done by palpation of it between the index and middle fingers of the operator's left hand (Fig 3), the tips of the fingers pointing toward the patient's feet. From a point equidistant between them the longitudinal incision of platysma, cervical fascia and ribbon muscles is carried out, an incision made thus will properly separate the ribbon muscles which may have been deflected to one side or the other by unequal enlargement of the two lobes. With the longitudinal incision guided by preliminary palpation of the larynx one follows the anatomical midline. If the goiter is large or the neck muscles particularly powerful, we obtain more room by a high cross division of the cervical fascia rather than by cross dividing the ribbon muscles. This is done by slipping the scissors transversely between the fascia and the muscle (Fig 4), at a point slightly below the apex of the upper pole then cutting the fascia for a distance of about 3 centimeters from the midline. This may be done on either or both sides. Retraction of the muscles, once this cross division of the fascia has been made, is easy and gives adequate exposure in all but enormous goiters. Small hemostats are left on the four points of fascia thus formed for approximation at closure.

Narrow retractors are inserted into the incision on the side to be approached first, one opposite

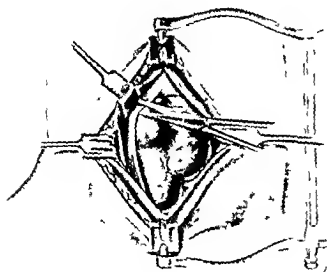


Fig. 5 Upper pole uncovered by sacrifice of sternothyroid muscle

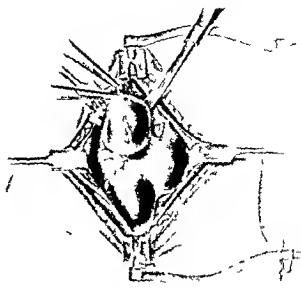


Fig. 6 Recurrence obviated by complete removal of upper pole

the main body of the lobe, the other opposite the upper pole. Retraction is maintained not only laterally but also upward "toward the ceiling." The sternothyroid muscle is seen crossing the lobe diagonally and is cross divided and sacrificed entirely (Fig 5), the retractors being replaced more deeply to include it as well as the fine film of cervical fascia which invests the anterior and lateral surfaces of the lobe and is readily separated from the true capsule of the gland. This proper "cleaning" of the gland and upper pole free of the minor muscle and fascial elements, often stuck to the capsule because of perithyroiditis, is most important in facilitating later delivery of the upper pole and the lobe itself without dangerous traction on them. The success of one's handling of the thyroid is throughout dependent to a large extent on one's appreciation of tissue planes and lines of cleavage, this is most strikingly true in dealing with large goiters and substernal or retrotracheal growths, and can readily be appreciated in seeing how a dexterous surgeon who is familiar with the problem will make such a gland seem to "pop up" into a position where it can be conveniently handled.

The retractors in the hands of the second assistant are now holding away the tissues investing the lateral aspect of the lobe, while we attack the upper pole. As was done in ligation, the pole is grasped, as high as possible, with a hæmostat and gently lifted up out of the neck toward the operator. At the same time a Kocher ligature carrier is inserted into the groove between the pole and the larynx and passed lat-

erally (Fig 6), and slightly superiorly, maintaining pressure against the pole with the Kocher and lifting the pole out of the neck until the point of the instrument can be felt and seen to have passed completely behind the pole. If any tissues remain covering the point of the Kocher, they may be carefully separated from the pole and pushed laterally by an assistant, thus freeing the Kocher entirely. It is highly important in order to avoid injury to the larynx that the larynx be not used as a fulcrum for depression of the handle of the Kocher, the pressure on the instrument need be only light, if one is in the proper layer immediately within the fascia surrounding the pole, and must be applied only in a lateral direction. During this maneuver, the index finger of the left hand may rest lightly against the lateral wall of the pole and toward its posterior surface, the difference between thyroid tissue and surrounding structures should be familiar enough that any tendency of the Kocher to penetrate the pole, thus leaving some of it, or to go too deeply can be instantly detected.

With the pole freed and lifted toward the operator, a downward pull is now maintained by the hæmostat first placed on it while the first assistant places hæmostats, their points directed transversely and slightly upward, on the lateral, anterior, and medial surfaces of the pole and completely divides it below them, one or two more hæmostats control the back bleeding. It is seen that there is no thyroid tissue remaining above an intact blood supply when the pole is dealt with in this way. This is, in our opinion, highly

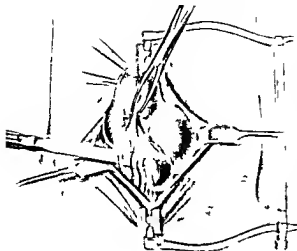


Fig. 7. Delivery of lower pole by traction on accessory veins etc

important for the majority of recurrences that come to us from other surgeons have their recurrences in the upper poles which clearly as seen at operation have never been exposed before. In no other way than by fully exposing and bringing up the tissue can really high poles be removed.

The delivery of the body of the lobe is next carried out. It is grasped toward its lateral surface by a fine toothed clamp and rotated medially and out of the neck. While this tension is maintained a flat instrument such as the Kocher ligature carrier or the closed blades of the scissors, is introduced into the cleavage plane between the thin investing fascia and the true gland capsule and as the communicating veins are encountered at the lateral inferior border of the lobe they are lifted (Fig. 7) on the point of the dissecting instrument and divided between hemostats; their medial portions are then used to help maintain the rotating and lifting tension on the lobe. This method of blunt and sharp dissection against constant tension is carried around the lower pole and then toward the mid line until the entire lobe can be brought up completely free of all attachments save those on its posterior surface and the opposite lobe. During this step, the point of application of traction on the lobe is shifted as the dissection proceeds, likewise the retractor in the hand of the second assistant is slid along so that it remains opposite the advancing point of dissection and provides the maximum room for the operator. With a retrotracheal growth or one that is largely sub

clavicular, tension on the gland is best maintained by a sharp toothed or 'cat's paw' retractor which is shifted to take a fresh grip as the lobe is rolled out of its bed. Strong traction on the gland is at no time safe or necessary. This method depends on the fact that the gland will literally roll out of its bed if the investing layers are dissected off in the proper plane against gentle tension. It will be noted that no mention has been made of manipulation or delivery of the gland by the operator's fingers. It is our custom to keep our fingers out of the neck except for the purpose of occasional palpation, never for manipulation of structures. Such handling is a fruitful source of injury to the recurrent nerve. The one occasion on which fingers are more useful than dangerous is in the delivery of a subclavicular lobe: once the upper pole has been delivered, the lateral veins divided and the proper tissue plane entered laterally, the operator's index finger may be introduced along this plane beneath the clavicle and used to strip off the tissues investing the capsule at the inferior margin of the lobe. Here again however, pressure is not exerted toward the gland but away from it, the delivery of the lobe being accomplished by upward rotation with a sharp toothed retractor as the investing tissues are stripped off the capsule.

Once the lobe has been delivered a row of hemostats is placed in position on the capsule from the point at which the posterior border of the upper pole joins the lobe around the lateral and inferior surfaces of the lobe to the midline (Fig. 8). These mark the plane of resection and in placing them the operator determines how much of the lobe shall be left in view of the character of the gland and the patient's toxicity and age. Behind this line no cutting or manipulation is to be done. The usual sites of the majority of the parathyroids and of the recurrent nerve are protected. After the lobe is marked for resection a fresh towel is placed across this side of the field, the second assistant moves to the opposite side of the table, and the opposite lobe is attacked in the same way by cross cutting the sternothyroid and stripping it laterally, delivering and dividing the upper pole, freeing the lateral and inferior margins of the lobe by blunt and sharp dissection against tension, delivering the lobe and applying the row of clamps marking the plane of resection.

We are now performing the actual amputation of the lobes with a high frequency 'knife' of the type being tested by the American College of Surgeons (Fig. 8). It is at its best on the

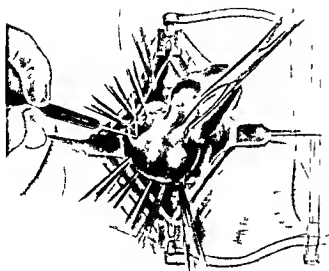


Fig 8 Resection plane identified before endotherm amputation

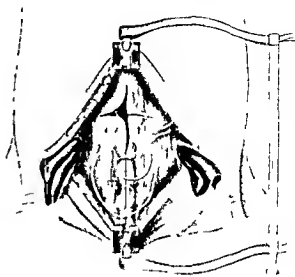


Fig 9 Prevent skin swallow "tug" by avoiding midline drains

diffusely hyperplastic glands in which ordinarily there is much capillary oozing. The instrument does away with this, so that fewer clamps are placed in the field, moreover, this effect of sealing the surface of the stump should, and probably does, somewhat decrease postoperative toxicity. Following amputation, the current is changed from "cutting" to "coagulating" and the bits of tissue held by hæmostats, except those on the upper pole, are touched with the instrument and the clamps removed. A few larger vessels will sometimes have to be caught again, in which case they are tied. We have occasionally done cases in which no ligatures whatever were necessary other than the transfixing and ligation of the upper poles. Unquestionably a tremendous saving in time of closure results in all cases and, as less catgut is left in the neck, there is a saving in catgut expense and less tendency to serum collection. The use of the high frequency knife will undoubtedly result in our doing fewer flap cutting operations in the future, since the time consuming ligation of bleeding points is so largely obviated. After amputation of the stump, the upper poles are transfixed with a suture and tied, all ligation necessary after coagulation is carried out and, if there is any tendency of the stump to be "wet," a running suture of catgut is whipped around the edge of the stump and brought across under tension and sutured to the stump of the upper pole, to produce pressure on the gland bed. The inhalation anæsthetic is taken away and the patient is roused sufficiently to strain or cough and the stump again inspected for bleed-

ing. It is preferable to have an overlooked vessel start oozing at this point rather than after the patient has been put to bed and first begins to talk and swallow.

Closure and drainage of the neck remain. We drain after practically all goiter operations. A narrow retractor is placed in the cavity and its handle elevated and pushed toward the midline so that the tip of the retractor presses outward and upward against the muscles and cervical fascia at a point just medial to the end of the skin incision. A small longitudinal incision through these layers is made with the high frequency knife sufficient to free the tip of the retractor to which a hæmostat is fastened and pulled through into the cavity by reversing the pull on the retractor. A Penrose drain, varying in length according to the amount of dead space to be filled, is placed between the blades of the hæmostat which are then locked and the instrument is withdrawn, bringing the tip of the drain with it. The portion of drain within the neck is carefully packed into the cavity on that side. Another drain is introduced into the opposite cavity in a similar fashion. They do not cross the trachea, but come out their respective sides (Fig 9). We are now ready for closure. The patient's head is raised, flexing the neck, and the four hæmostats marking the four corners of the cervical fascia (if the fascia was cross cut) are brought together and transfixed by a suture. An additional suture may be placed laterally on each side if the cross division has been over 2 centimeters long. This suture is tied and con-



Fig 10 Adequate fat plastic means thin loose skin scar

tinued downward, uniting the cervical fascia in the midline throughout the length of the longitudinal incision (Fig 9). We have thus avoided crossing the trachea with drains and bringing them through the midline incision in the fascia. This is of great value in avoiding fixation of the incision to the trachea, especially in the case of very large goiters the removal of which leaves much dead space. The automatic retractors are now removed from the upper and lower flaps and a careful search for bleeding under the flaps is made after we have removed the tension on them. Three to five interrupted sutures are placed in the fat (Fig 10), if this step is accurately done the skin edges will be found nicely approximated and suture of the skin is necessary only to prevent displacement of the levels during the few hours required for scaling off the skin edges. The sutures in the fat pad take the tension, moreover, off the skin sutures. We use No 0000 Chinese silk, swedged on to No 12 non cutting needles, for the skin, starting a continuous suture from the midline laterally on each side to the point at which the drain protrudes at the extreme

angle (Fig 10) of the incision. Skin sutures are removed in 24 hours, drains are removed half way at 24 hours and entirely at 48 hours unless the goiter has been very large, in which case they remain longer.

We have emphasized the importance to the final cosmetic result of (1) accurate dissection of the entire fat pad along with the skin flaps, (2) avoidance of cross cutting the sternohyoid and omohyoid substituting cross division of the fascia instead, (3) complete closure of the longitudinal incision in the cervical fascia, and (4) accurate suture of the fat pad in closure. In those cases which occur sometimes, though rarely, in which we have either not closed the neck at operation or have had to reopen it later for any purpose, we take advantage of the first, third, and fourth of the points mentioned in doing *secondary closure*. There is always a certain amount of infection in such a wound and sufficient time must be allowed for this to have fairly well cleared up, as well as for the patient to have recovered entirely from the situation that precipitated the emergency resulting in the incision's having been left unsutured or reopened. This period is usually from 10 days to 2 weeks. Under very light nitrous oxide inhalation the fat pad is stripped back from whatever position in which it has become adherent in both upper and lower flaps. One or two sutures draw the cervical fascia together over the larynx and upper trachea. The entire thickness of the flaps is then strongly everted above and below, brought together, and secured by several interrupted sutures passing only through the fat. A single, narrow flat strip of rubber lies transversely beneath the fat and protrudes at either angle of the incision. No sutures are placed in the skin, since approximation of the fat in marked eversion of the edges of the flaps will lead to gradual approach and union of the skin edges in spite of the inversion resulting from the previous inflammation and oedema, the drain is removed in 2 or 3 days. We have had the best results from dealing with secondary closures in this way.

ARTHRODESIS OF HIP¹

WITH SPECIAL REFERENCE TO A METHOD OF SECURING ANKYLOSIS IN MASSIVE
DESTRUCTION OF THE JOINT

LEROY C ABBOTT, M.D., F.A.C.S., SAN FRANCISCO CALIFORNIA

AND

FREDERICK J FISCHER, M.D., DETROIT, MICHIGAN

THE purpose of this paper is to describe a method of performing arthrodesis of the hip in children in whom tuberculous or pyogenic infection has caused massive destruction of the joint. In the typical case for which this method is especially suitable, the head and neck of the femur have been completely destroyed and the acetabulum has been markedly eroded. The upper end of the femur represented by the great trochanter may lie near the acetabulum or may be displaced upward on the wing of the ilium. In either position it is commonly fixed by scar tissue, cartilage, or bone (Figs 1, 4, and 7).

Important clinical findings in this group of patients are limp, a limited range of motion which is often painful, deformity, and instability of the joint. The indications for treatment therefore are (1) correction of the deformity and (2) the production of a painless and stable joint by arthrodesis.

In our experience, correction of deformity has readily been secured but the production of bony ankylosis has been difficult to accomplish. Frequent failure to obtain bony fusion by any of the commonly accepted methods of arthrodesis has led to the development of a procedure which has been highly successful in the treatment of this rather difficult group of patients. This procedure is carried out in several stages: (1) correction of deformity, (2) arthrodesis of the hip in wide abduction, and (3) reduction of the widely abducted position by subtrochanteric osteotomy.

CORRECTION OF DEFORMITY

In the majority of our patients, the disease was quiescent as far as could be determined by clinical and roentgenological examinations. Deformities of flexion and adduction, together with shortening, were of common occurrence. In the patient with a moderate degree of deformity, correction was generally secured by gradual stretching of the contracted flexor and adductor group of muscles with adhesive traction. In the more severe deformities, correction was obtained by freeing the great trochanter from the wing of the ilium and applying heavy traction to a steel pin which

had been drilled through the lower end of the diaphysis of the femur. With either type of traction the affected extremity was gradually brought to a position of wide abduction. Traction plus wide abduction brings the great trochanter adjacent to the acetabulum so that these two structures can more readily be placed in apposition at the time of arthrodesis.

ARTHRODESIS OF THE HIP IN WIDE ABDUCTION

It has been our experience that the usual method of approximating the denuded upper surfaces of the great trochanter and acetabulum frequently fails to secure bony ankylosis. Fibrous union and recurrence of deformity is common. We believe that fusion occurs infrequently because of the small areas of bone which are apposed to one another. Furthermore, we have often failed to secure bony ankylosis by any of the so-called extra-articular methods. We attribute our failures to difficult technical problems involved in dealing with this particular type of case, i.e., massive destruction of the head of the femur, and to incomplete fixation. Neither have we had any great success in those cases in which a combination of intra-articular and extra-articular arthrodeses has been employed.

In the method which we are now using, we appose extensive bone surfaces under complete fixation and pressure. In more detail, the operation is conducted as follows. Through a Smith-Petersen incision the acetabulum and upper shaft of the femur are exposed. Scar tissue and cortical bone is then removed from the upper and inner surfaces of the acetabulum and the superior, anterior, lateral, and posterior surfaces of the great trochanter and upper shaft of the femur until fresh cancellous bone is exposed. The extremity is now placed in wide abduction thus forcing the tip of the great trochanter well within the acetabular cavity. This permits the superior and lateral surfaces of the great trochanter and the upper lateral aspect of the shaft of the femur to lie in intimate contact with the superior and internal surfaces of the acetabulum. No attempt is made at this time to secure the correct position of the

¹From the Shriners Hospital for Crippled Children and the Department of Surgery of Washington University.



Fig. 1 Destruction of the head and neck of the femur and acetabulum. Note marked abduction deformity. (Case 1.)

hip for weight bearing. The single aim of the operation is to obtain bony ankylosis.

The degree of abduction varies with the individual case. In some, 30 degrees may be sufficient; in others 70 to 90 degrees may be required in order to secure accurate fitting and wide apposition of the bony surfaces (Figs. 2 and 5). We feel that the chances of a bony union are much increased by securing the widest contact of bony surfaces under complete fixation and firm pressure. These principles of treatment are fulfilled by wide abduction of the extremity.

The wound is now closed and fixation is secured by the application of a double plaster of Paris spica extending to the toes on affected side and to just above the knee on unaffected side.

The next step is to determine by accurate measurements the exact position of the hip which will produce the best possible function of the extremity. The degree of flexion and abduction is estimated for the individual case largely on the amount of shortening present. It is well to remember, however, as shown by A. O. Adams in his recent article¹ that abduction of the hip beyond a certain number of degrees is not desirable because of the marked tilting of the pelvis and the awkward gait which it produces. In certain cases in which ankylosis is secured by a minimum amount of abduction, no change in position may be necessary. On the other hand, patients with ankylosis in extreme abduction require cor-

rection of the faulty position by osteotomy of the femur.

CORRECTION OF THE POSITION OF WIDE ABDUCTION BY OSTEOTOMY

Reduction of the degree of abduction is secured by a transverse subtrochanteric osteotomy followed by gradual bending of the callus. This simple method was described in a recent article.² Its advantages over other types of osteotomy lie in its simplicity of execution and the fact that it reduces to a minimum the danger of displacement of the fragments.

In more detail our procedure in these widely abducted hips is to bivalve the plaster spica which has been used for fixation following the arthrodesis. This spica is retained for immobilization following osteotomy.

In the operating room after the usual skin preparation the anterior limb of the Smith-Petersen incision which was used for the operation of arthrodesis is incised and the tensor fascia femoris is separated from the sartorius. The rectus femoris is then retracted inward thus exposing the periosteum of the femur between this muscle and the vastus lateralis. At this stage of the operation it may be necessary to ligate branches of the lateral circumflex artery. The periosteum is then incised and a transverse osteotomy performed just below the level of the lesser trochanter. This brings the site of osteotomy as close to the ankylosed joint as practical. The wound is then closed and the bivalved plaster of Paris spica is reappplied and held in place with adhesive or a few turns of plaster of Paris bandage. No attempt is made at this time to change the position of the extremity.

Two weeks after this operation the hip is examined and roentgenograms are taken. If the roentgenogram shows beginning callus formation and the clinical examination indicates some fixation of the fragments, we remove the spica and apply adhesive tape to both lower extremities. A Thomas splint is used to support the side operated upon. With the affected extremity held in its initial position of abduction and the normal extremity in line with the trunk, a weight with a pulley is attached to the ends of the adhesive tape traction. Traction on the unaffected side controls the position of the pelvis. Each day reduction of the degree of abduction is effected by changing the axis of traction until the position determined upon before operation is obtained. Flexion of the desired amount, usually 0 to 25

¹Wald L. C. and Jones F. A. Surg. Gynec. & Obst. 1936 63: 274.
²Ibid.



Fig. 2 Bony ankylosis after arthrodesis in wide abduction (Case 1)

degrees, is then secured by elevating the lower end of the Thomas splint

The time required for bending of the callus is usually 10 days. Having obtained the desired position, the patient remains with the traction in place until the callus at the site of osteotomy is consolidated. During this interval massage and motion of the knee are instituted and the position of the extremity is frequently checked up by measurements and roentgenograms. It has also been our practice 4 or 5 weeks after osteotomy, to remove the Thomas splint, bring the legs parallel, and carefully check the position by measurements.

A great advantage of the method, aside from those already mentioned, is that it permits the correction of the abduction and the determination of the exact position desired by frequent observation and measurements. An osteotomy with a complete correction at the time of operation followed by fixation in plaster does not possess this important advantage. This procedure has proved so satisfactory that we have discarded the older methods of osteotomy except in the simpler cases requiring a minimum amount of correction.

RESULTS

Eleven patients with advanced destruction of the hip have been treated by this method. The youngest patient was 7 years of age, the oldest 15. The average age was 11.2 years. In 9 cases the disease was quiescent while in 2, the activity of the destructive process was evident because of the presence of discharging sinuses. The results secured in these two infected cases are of interest. In the first case incomplete ankylosis with one



Fig. 3 Correction of widely abducted position by subtrochanteric osteotomy and bending of the callus (Case 1)

small discharging sinus remains after a period of 11 months. In the second case clinical ankylosis with healed sinuses is present after 14 months. Though difficult to form judgment from the experience gained with but 2 cases, it would seem that in the presence of sinuses, ankylosis is likely to be delayed or may not occur at all.

In the 9 quiescent cases operated upon, bony ankylosis has occurred in 7 (Figs 2, 6, and 9). In 1 case incomplete ankylosis is present after 1 year and must be classed as a failure. In a second case, beginning bony ankylosis is shown in the roentgenogram 4 months after operation. It is too early, however, to include this patient in the end-results. In the 7 remaining cases, the average time in which the X-ray gave evidence of beginning ankylosis was 4.2 months. The average length of time elapsing between the operation of arthrodesis and the correction of wide abduction by osteotomy was 5.9 months.

The results have been highly satisfactory in all cases treated by this method except those who have had discharging sinuses. The patients are able to walk and sit with comfort and none of them has pain. We believe that these satisfactory results are due to bony ankylosis secured with the joint held in the best possible position for future function. We wish to emphasize the importance of careful check-up measurements in order to be certain that the position for maximum function is secured.

CASE REPORTS

CASE 1. M. W., aged 11 years, was admitted November 13, 1925, complaining of stiffness and deformity of the left hip. In 1917, at the age of 3 years, the patient fell from a



Fig. 4 Extensive destruction of the head and neck of the femur with marked erosion of the acetabulum. There was marked flexion and adduction deformity. (Case 3.)

second story window injuring the left hip. One week later she began complaining of pain in the hip and was removed to a hospital where X rays were taken and treatment was instituted by means of traction and later the application of plaster.

At the time of admission to the Shriners Hospital there was no pain or tenderness in the hip but the patient complained of limp, shortening, stiffness and deformity.

The general physical examination was essentially negative. The left hip was held in a position of 30 degrees flexion and 20 degrees adduction with a few degrees of motion in flexion and extension. There was 3 inches of true shortening of the left lower extremity, most of which was confined to the femur. The foot was held in marked equinus and the patient walked with a decided limp. There was also a marked compensatory lordosis in the lumbar spine.

The roentgen ray examination October 9, 1925 showed an old destructive process of the left hip joint with complete disappearance of the head and neck of the femur and outline of the acetabulum. There was an upward displacement of the upper extremity of the femur. The diagnosis was old tuberculosis of the left hip joint with pathological dislocation (Fig. 2).

Operation. On November 16, 1925, a section of the adductor muscles was done and a Steinmann pin was inserted in the lower end of the left femur. Traction was applied and slowly increased to 50 pounds. The position of the extremity was gradually changed to one of wide abduction.

On December 10, 1925, the deformity was completely corrected. An arthrodesis of the hip was performed in a position of wide abduction. A plaster of Paris spica was applied. The patient's postoperative convalescence was entirely uneventful and she was discharged in a solid hip spica on February 22, 1926.

On July 23, 1926, the patient was readmitted to the hospital. Clinically the hip was solidly ankylosed. The roentgen ray examination August 7, 1926 showed solid ankylosis of the hip joint (Fig. 3).

Operation. On September 23, 1926, a subtrochanteric osteotomy of the left femur was done. This was followed by

a gradual bending of the leg, until a position of 25 degrees flexion and 2 degrees abduction was secured. A double spica was applied and the patient was discharged.

A check up roentgen ray examination January 12, 1927 showed abundant callus formation with good alignment of the fragments. A walking plaster was applied and the patient was discharged (Fig. 3).

Subsequently the patient gained 1½ inches length by lengthening of the tibia and fibula.

On March 6, 1929, examination revealed the hip to be solidly ankylosed in 25 degrees flexion and 2 degrees abduction. There remained a true shortening of 1½ inches and an apparent shortening of 1¼ inches of the left lower extremity.

The patient assumed a fair sitting position and was able to climb stairs one foot at a time and complained of no pain in either the hip or back. The gait was markedly improved.

CASE 2. W. C. aged 13 years was admitted to the hospital October 13, 1925, complaining of deformity of the left lower extremity. In 1917, at the age of 4 years, the patient became acutely ill, the onset being marked by pain in both lower extremities. The acute symptoms continued for 1 month and at this time the patient showed evidence of cerebral involvement, being unconscious most of the time. At the end of the illness the left hip became markedly swollen, painful and tender. The patient was removed to a hospital where a plaster spica was applied. This treatment was continued for a period of 7 months at the end of which time the cast was removed. There was no subsequent treatment.

At the time of admission to the Shriners Hospital the patient walked with a considerable limp. The foot was held in equinus to compensate for the shortening which was present.

The physical examination disclosed that the patient was a very markedly undersized and undernourished boy of 13 years. The general physical examination otherwise was essentially negative. The left hip was fixed in a position of 70 degrees flexion and 10 degrees adduction. There was 20 degrees range of motion in flexion and extension. The trochanter was high above Nélaton's line. There was no tenderness or sensitiveness about the joint. The left leg was 2 inches short and the patient walked with a very awkward gait.

Roentgen ray examination revealed complete destruction of the head and most of the neck of the femur with an upward dislocation of the upper extremity of the femur. The diagnosis was old tuberculosis of the hip joint with pathological dislocation.

Operation. On October 19, 1925, a section of the left adductor muscles and a fasciotomy of the left hip flexors followed by manipulation of the left hip was done.

Operation. On November 23, 1925, an intra-articular arthrodesis of the left hip was done. The postoperative convalescence was quite uneventful and the patient was discharged in a plaster spica.

The check up roentgen ray examination January 26, 1927, showed partial ankylosis of the hip joint. Clinically the hip appeared to be drifting into a position of deformity.

On March 8, 1927, the patient was readmitted to the hospital. Clinical and roentgen ray examination showed the left hip to be unstable and in a position of adduction.

Operation. April 4, 1927, the stump of the femur was freed from the acetabulum and a Steinmann pin was placed in the lower end of the femur. This was followed by the application of traction and a gradual correction of the deformity was obtained.

Operation. May 2, 1927, an arthrodesis of the left hip was done after the method described and was maintained.



Fig 5 Roentgenogram taken 3½ months after arthrodesis in wide abduction (Case 3)

in a plaster spica. Immobilization was continued until April 6, 1928, at which time the hip appeared to be solidly ankylosed.

December 12, 1928, measurements showed the hip to be in a position of 19 degrees' abduction and 30 degrees' flexion. There was 3 inches of true shortening and 1½ inches' apparent shortening. Clinical and roentgen ray examination showed the hip to be solidly ankylosed.

The patient walked very well with a ¾ inch lift under the left shoe. He assumed a good sitting position and was able to climb stairs fairly well. The patient complained of no discomfort in the back and was well satisfied with the result.

CASE 3 V W, aged 12 years, was admitted September 6, 1927, complaining of a deformity of the left hip and shortening of the left lower extremity. In 1910 at the age of 4½ years, the patient developed a limp at intervals of 3 or 4 months over a period of 1 year. At the end of this time he developed a rise in temperature and complained of severe pain in the left hip associated with night cries. Walking finally became impossible and a plaster spica was applied. After 6 months this was removed and a brace applied which was worn for 1 year. Three years previous to admission, an abscess of the left hip developed which was incised and drained. At the time of admission there was no pain about the hip but the patient walked with an extreme limp.

The general physical examination was essentially negative. The left hip was fixed in a position of extreme flexion and adduction with only a few degrees' range of motion in flexion and extension present. All sinuses were healed. There was no tenderness or sensitiveness about the joint. Measurements showed 3½ inches' true shortening of the left lower extremity, most of which was confined to the femur. The patient walked on the ball of the foot and toes with a very awkward gait and decided limp. There was also a marked compensatory lordosis of the lumbar spine.

The roentgen ray examination revealed an extensive destructive process involving the head and neck of the femur



Fig 6 Roentgenogram showing solid bony fusion 14 months after arthrodesis (Case 3)

and the acetabulum. There was complete absence of the head of the femur, almost complete absence of the neck, and an upward erosion of the acetabulum. The diagnosis was old tuberculosis of the left hip joint (Fig 4).

Operation. On September 12, 1927, a tenotomy of the left hip flexors and adductors and an insertion of a Steinmann pin in the lower end of the femur was done. Traction was applied and the deformity was gradually corrected.

Operation. On November 18, 1927, an arthrodesis of the hip was done, the hip being placed in a position of wide abduction and maintained in a plaster spica.

The roentgen ray examination, March 3, 1928, showed bony proliferation around the joint with evidence of early ankylosis (Fig 5).

Operation. On April 2, 1928, a subtrochanteric osteotomy of the left femur was done followed by a gradual bending of the leg into a position of 15 degrees' abduction and 22 degrees' flexion.

On August 9, 1928, the patient was discharged from the hospital, walking with crutches and a ¾ inch lift on the sole of the left shoe.

February 6, 1929. Examination at this time revealed the hip to be solidly ankylosed clinically and by X ray examination in a position of 15 degrees' abduction and 22 degrees' flexion (Fig 6). There was 3 inches of true and ½ inch of apparent shortening of the left lower extremity. It required a ¾ inch block under the left shoe to make the legs appear equal in length. The patient walked with only a very slight limp. He was able to climb stairs well and assumed a good sitting position. There was no pain or discomfort in the back. The gait was improved and the lumbar lordosis was decreased.

CASE 4 L K, aged 7 years, was admitted to the hospital March 1, 1927, complaining of a deformity of the right hip and a limp. In 1922 at the age of 2 years the patient developed an attack of pneumonia. Several days following the onset he began complaining of pain in the right hip. There was no apparent swelling of the hip but it gradually became drawn up into a position of flexion and was exceedingly painful on manipulation. The patient was unable to walk for a period of 1 year and then with a very pronounced limp.



Fig 7 Roentgenogram showing destruction of the right hip joint with extreme adduction deformity (Case 5)

Two years previous to admission patient fell injuring the right hip. Two days later he complained of severe pain and inability to walk. He was confined to bed and a splint was applied to the leg. One week previous to admission the splint was removed and the patient began walking. The limp, however, was more pronounced and the patient complained of pain in the hip joint at intervals.

The patient was a fairly well developed and nourished rather pale looking boy of 7 years. Otherwise the general physical examination was essentially negative. The patient walked with an awkward lurching gait somewhat like that seen in congenital dislocation of the hip. Motion in the hip joint was quite free in flexion, extension and rotation but limited in abduction. The great trochanter was displaced above McClure's line and there was 2 inches of true shortening most of which was confined to the femur.

The roentgen ray examination revealed a complete destruction of the head of the femur and almost complete destruction of the neck. The acetabulum showed an old destructive process with upward erosion on to the wing of the ilium.

Operation. On March 3, 1927, an arthrodesis of the right hip was done the hip being placed in a position of wide abduction and maintained in a plaster spica. The postoperative convalescence was uneventful.

On August 15, 1927, the hip appeared to be solidly ankylosed clinically and by roentgen ray examination. Accordingly a subtrochanteric osteotomy of the right femur was done followed by gradual bending of the leg, into a position of 12 degrees abduction and 22 degrees flexion. During the bending process the distal fragment became displaced medially along the shaft of the proximal fragment. The fragments, however, united solidly.

On March 6, 1928, the patient was discharged wearing a $\frac{1}{4}$ inch lift on the sole of the right shoe to compensate for the remaining apparent shortening.

March 13, 1929. The patient last presented himself for examination. The hip was found to be solidly ankylosed in a position of 12 degrees abduction, 22 degrees flexion and slight external rotation. There remained 2 inches of true shortening of the right lower extremity with $\frac{3}{4}$ inch apparent shortening. The patient walked with a very slight limp, assumed a good sitting position and was able to climb stairs well. The patient has been leading a very active life with no discomfort in either hip or back.

CASE 5. N. C. aged 11 years was admitted June 22, 1924, complaining of stiff hip on the right. In 1920 at the age of 2½ years the patient fell injuring the right hip. No subsequent disability was noticed until 6 months later when he developed a limp. One year later the patient became acutely ill with an associated tender and red swelling of the right hip. This soon ruptured spontaneously and the patient continued to have draining sinuses until 1 year previous to his admission.

At the time of admission to the Shriners Hospital the hip was not painful. The patient walked with an awkward limp on the ball and toes of the right foot.

The patient was a fairly well developed and nourished boy of 11 years. The general physical examination was essentially negative. There was a marked flexion and adduction deformity of the right hip. The hip was not tender or painful and a few degrees range of motion was present. There was 1 inch of true shortening of the right lower extremity. Scars of previous sinuses were present above the greater trochanter and in the groin.

The roentgen ray examination revealed an old destructive process of the right hip joint with complete absence of the head and greater part of the neck of the femur. There was also complete loss of the upper outline of the acetabulum with upward erosion on the ilium (Fig. 7).

Operation. On June 25, 1928, a section of the adductor muscles and insertion of a Steinmann pin in the lower end of the femur was done. Traction was applied and the deformity corrected.

Operation. On July 23, 1928, an arthrodesis of the right hip was done after the method described.

The roentgen ray examination October 24, 1928, showed a fair degree of ankylosis to be present (Fig. 8). The check up measurements at that time showed the hip to be in a position of 25 degrees abduction and no flexion. There was 2 inches of true shortening of the right lower extremity.

Operation. On January 24, 1929, a subtrochanteric osteotomy of the right femur was done followed by gradual bending of the leg into a position of 13 degrees abduction and 22 degrees flexion.

The roentgen ray examination March 23, 1929 (Fig. 9) showed the fragment in good position with abundant callus formation. The hip joint appeared to be solidly ankylosed. Clinically the hip joint was solid. A walking spica was applied with a $\frac{3}{4}$ inch lift under the right shoe to compensate for the remaining apparent shortening and the patient was gradually permitted to bear weight.

December 18, 1929. The out patient examination showed the sinuses to be healed. The hip was solidly ankylosed in a position of 12 degrees abduction and 25 degrees flexion. One inch of apparent shortening remained.

CASE 6. M. R. aged 15 years was admitted March 5, 1929, complaining of deformity of the left hip. In 1923 at the age of 9 years the patient began complaining of pain in the left hip and developed a limp. She was treated by means of traction and finally an arthrodesis of the hip was done. Previous to the operation the patient developed numerous sinuses about the hip. Following operation the wound did not heal completely until after a period of 1 year. Since that time the patient has walked with a severe limp and during the last year a curvature of the spine has



Fig. 8 Roentgenogram taken 3 months after arthrodesis. Note beginning ankylosis (Case 3)

been noticed. After moderate exertion the patient complained of generalized back pain.

The general physical examination revealed a well developed and nourished girl of 13 years with a mitral heart lesion but she was otherwise essentially negative. The patient walked with a very awkward gait with a 3 inch lift under the left shoe. The hip was in a position of 10 degrees adduction and 25 degrees flexion with slight motion in flexion and extension present. There was 2 inches of true shortening of the femur.

Roentgen ray examination revealed almost complete destruction of the hip joint with no evidence of bony ankylosis.

Operation. On April 8, 1929 an intra articular arthrodesis employing the above described method was done. The clinical and roentgen ray examinations, October 2, 1929 showed the hip to be solidly ankylosed.

Operation. On October 21, 1929 a subtrochanteric osteotomy was done followed by a gradual bending of the leg into a position of 6 degrees abduction and 25 degrees flexion. Two months later the patient was discharged.

March 18, 1930. The patient was readmitted for a femur lengthening. The roentgen ray and clinical examinations showed the hip to be solidly ankylosed in a position of 6 degrees abduction and 25 degrees flexion.

CASE 7. A. B., aged 9 years, was admitted October 18, 1929 complaining of a limp and shortening of the left leg.

In 1920 at the age of 2½ months the patient developed an acute tender swelling about the left hip and thigh, associated with night cries and an elevation of temperature. Six weeks later an abscess ruptured on the inside of the thigh. This was followed by the appearance of several other abscesses which drained for the next 12 months. There had been no draining since and no recurrence of the acute symptoms. The patient began walking at the age of 1½ years and has always had a limp.

The patient was an otherwise healthy boy of 9 who walked with an awkward limp resembling that seen in congenital dislocation of the hip. Further examination revealed a positive Trendelenburg sign and the trochanter was elevated above Nélaton's line. The motion was free in all directions with the exception of abduction which was markedly limited. There was considerable telescoping of



Fig. 9 Bony ankylosis of the joint and correction of wide abduction by subtrochanteric osteotomy and bending of the callus (Case 5)

the hip and 1½ inches true shortening of the left lower extremity.

The roentgen ray examination, October 18, 1929, revealed the left hip to have been the site of an old destructive process with complete destruction of the head and neck of the femur and a pathological dislocation of the upper end of the shaft of the femur upward on to the ilium. The acetabulum likewise revealed considerable destruction with upward erosion on to the ilium. There was no evidence of recent activity.

Operation. On October 24, 1929 a Steinmann pin was inserted in the lower end of the femur and traction applied.

Operation. On November 27, 1929 an arthrodesis of the right hip after the method described was done.

The roentgen ray and clinical examination, March 10, 1930, revealed solid bony ankylosis of the hip.

Operation. On March 17, 1930 a subtrochanteric osteotomy was done followed by gradual bending into the corrected position.

CASE 8. D. F., aged 8 years, was admitted to the hospital October 11, 1929 complaining of a limp and a shortening of the right leg. In 1925 at the age of 4 years the parents first noticed a slight limp in the right leg. Shortly after this the patient began complaining of pain in the right hip and it was noticed that she had a daily afternoon rise in temperature. The above symptoms gradually increased in severity and 1 year later a hip spica was applied. This was maintained for an additional year after which traction was applied for 7 months. Finally an operation was performed. Eight weeks later, the patient was allowed up and has limped ever since.

Physical examination disclosed a fairly well developed and nourished girl of 8 years with a 70 degree flexion, adduction and external rotation deformity of the right hip. The patient walked with crutches on the toes and ball of the right foot. There was 30 degrees motion in flexion and extension of the hip but all other motions were nil. The femur was 2½ inches short.

The roentgen ray examination, October 11, 1929, revealed the right hip joint to have been the site of an extensive destructive process with complete destruction of the head

and neck of the femur. There was an upward erosion of the acetabulum on to the wing of the ilium and no evidence of ankylosis.

Operation. On October 31, 1929, a section of the adductor muscles and the insertion of a Steinmann pin in the lower end of the femur followed by traction was done.

Operation. On December 2, 1929, an arthrodesis of the hip in wide abduction was performed.

The roentgen ray and clinical examination March 22, 1930, revealed definite evidence of beginning bony ankylosis.

CASE 9. F. P. aged 10 years was admitted to the hospital January 18, 1929, complaining of deformity of the left hip. In 1923 at the age of 6 years the patient suddenly developed acute pain in the left hip associated with tenderness. There was a slight elevation of temperature but otherwise no constitutional symptoms. He was confined to bed for several weeks after which he walked with a limp. One and one-half years later several sinuses developed in the region of the hip which drained until 8 months previous to admission.

The general physical examination revealed a somewhat undernourished boy of 10 years but was otherwise essentially negative. The patient walked on the toes of the left foot with an awkward limp and an associated extreme lordosis. There was a 48 degree flexion and 14 degree adduction deformity of the hip with a few degrees of motion in flexion and extension. All other motions were nil. There was no sensitiveness about the joint. The left lower extremity revealed a 1/2 inch of shortening.

The roentgen ray examination showed the left hip to be the site of an extensive destructive process with complete disappearance of the head and greater portion of the neck and invasion of the acetabulum.

Operation. On February 25, 1929, the deformities of the hip having been corrected by traction, an arthrodesis placing the femur in wide abduction was done. A solid hip spica was applied.

The roentgen ray examination August 23, 1929, showed beginning ankylosis. Gradual weight bearing was started. Four days later check up measurements showed the hip to be drifting into a position of deformity. A solid walking spica was applied and the patient was discharged.

March 20, 1930. Readmitted for femur lengthening. The position of the hip had remained unchanged.

The roentgen ray examination showed a moderate degree of ankylosis present.

CASE 10. F. H. aged 10 years was first seen in the Out Patient Department November 6, 1925, complaining of pain in the left hip and a limp. One year previously the patient fell injuring the hip. This was followed by slight pain and a persistent limp. He was removed to a hospital where a diagnosis of tuberculosis was made and conservative treatment carried out. The patient walked with a slight limp on the left. The hip was slightly flexed with limitation of motion in all directions associated with muscle spasm. There was no sensitiveness about the joint. However, Roentgen ray examination revealed a subepiphyseal destructive process of the neck of the femur with apparently no involvement of the joint proper.

On January 29, 1926, the patient was admitted to the Shriners Hospital because of an increasing flexion deformity of the hip and increasing destruction of the neck of the femur as shown in the X ray.

Operation. March 15, 1926, a drainage of the neck of the femur through the great trochanter was done.

March 6, 1928. The patient had been under observation for 2 years during which time two abscesses were aspirated and two sinuses had developed, one over the great trochanter and one in the groin. The hip was in a position of

25 degrees flexion 14 degrees' adduction and slight internal rotation.

May 2, 1929. Readmitted for drainage of an abscess in the region of the great trochanter.

The roentgen ray examination revealed complete destruction of the head and neck of the femur with involvement of the acetabulum. The hip was in a position of 44 degrees flexion 27 degrees adduction and slight internal rotation.

Operation. On May 18, 1929, an incision and drainage of the abscess was done.

Operation. June 3, 1929, an arthrodesis of the hip after the manner described was done, the wound being packed wide open. Microscopic examination of the tissue removed showed active tuberculosis.

On September 24, 1929, the patient was discharged on a walking hip spica. Clinically the hip appeared to be solid. The roentgen ray examination showed definite beginning bony ankylosis.

October 18, 1929. The patient returned with the entire wound broken down and discharging. There was definite motion of the hip joint present.

May 7, 1930. Since admission the patient has been treated by means of traction, heliotherapy and rest. One small sinus still remains. Motion in the hip joint is present. The roentgen ray examination shows no evidence of ankylosis. The patient's general condition is excellent.

CASE 11. J. D. W. aged 12 years was admitted October 19, 1928, complaining of a deformity of the right hip. In 1920 at the age of 4 years the patient fell bruising the right hip. He was able to get around but complained of considerable pain in the region of the hip and walked with a limp. During the next 4 years the patient continued to have pain in the hip often referred to the knee with an associated limp at irregular intervals. The symptoms gradually increased in severity until at the end of that time a plaster cast was applied and maintained for 1 year. The patient was then allowed to walk with crutches. Since that time at intervals of about 1 year three abscesses have developed associated with swelling of the hip pain and temperature necessitating drainage. At the time of admission the patient still had one sinus present.

The general physical examination revealed an undernourished boy of 12 years but was otherwise essentially negative. The patient walked on the toes of the right foot with an associated limp. The hip was held in a position of deformity of 65 degrees flexion and 15 degrees adduction. There were a few degrees of motion present in flexion and extension. There was one draining sinus over the posterior aspect of the hip. The femur was 2 inches short.

The roentgen ray examination revealed marked destruction of the right hip joint with disappearance of the greater portion of the head and neck of the femur and also involvement of the acetabulum.

Operation. On November 12, 1928, an arthrodesis of the hip after the manner described was done. A posterior approach was employed and the wound was packed open.

On May 11, 1929, the clinical examination showed slight motion still present in the joint. There was present one draining sinus in the operative scar. A walking hip spica was applied.

June 30, 1929. The spica was removed. There was no evidence of ankylosis either clinically or by roentgen ray examination. Weight bearing without support was started and the patient discharged.

March 10, 1930. The patient returned 16 months after operation with the general condition very much improved. The sinus had been closed for 3 months. There still was slight motion present in the hip but check up measurements showed no recurrence of deformity.

SUMMARY

1 In this article we have described a method of arthrodesis of the hip in massive destruction of the joint. This method is based on fundamental principles of treatment, namely the apposition of wide areas of cancellous bone under complete fixation and firm pressure. Failure is most often due to neglect of these fundamental principles.

2 The special method which we have devised calls for wide abduction of the limb. No attempt

is made to obtain the best functional position of the extremity at the time of arthrodesis.

3 Correction of the abducted position is secured by transverse osteotomy and gradual bending of the callus. This method of osteotomy is simple, minimizes the dangers of displacement of the fragments, and permits frequent inspection and measurements of the extremities to determine the best functional position for weight bearing.

TORSION AND VOLVULUS OF THE STOMACH

WAYLAND A. MORRISON, M.D., F.A.C.S., LOS ANGELES, CALIFORNIA

TOTAL volvulus and complete torsion of the stomach are rare lesions. Recognition of them as pathological entities is comparatively recent. Berti, in 1866, was the first to report the condition of complete volvulus found in a patient at autopsy. Berg, in 1895 was the first to operate. He reported 2 cases, 1 total and 1 partial. Since then others have been reported occasionally. Kocher, who had a personal case of total volvulus in 1914, reviewed the literature of the subject and found 28 cases. Up to 1924 additional instances were reported by Niosi and Siegel, that of the latter being in a child 2 years of age. In 1923, Max Thorek, of Chicago, reported a case of total volvulus and summarized the literature. Laewen, in 1927, stated that there were about 40 known cases.

Thorek's case gives a typical picture of acute volvulus in a woman 77 years of age. There was no previous history of gastric trouble. She had been constipated for 3 days and had eaten heartily of indigestible food. After examination the case was diagnosed as acute intestinal obstruction and stricture at the cardiac end of the stomach. When the abdomen was opened the condition found at first suggested a twisted, high ovarian cyst, but was found to be a stomach volvulus of 270 degrees on the horizontal axis. The pylorus was displaced to the left and the transverse colon was vertical and above the lesser curvature. Detorsion was effected following puncture and evacuation and a gastropexy done according to the Rovsing method. The patient made a good recovery.

The necessity arises here of distinguishing between volvulus and torsion. Becker deals with this aspect, differentiating between *volvulus* (*Magenverschlungung*) and *torsion* (*Magenver-*

drehung). According to him a true volvulus means a rotation of the whole viscus between the pylorus and cardia, these being the points of suspension, while torsion indicates that rotation has taken place about the other axis. Becker states that several of the cases reported in the literature as volvulus are really partial torsions, including those of Weiss and Meisels, in neither of which were there any acute, stormy symptoms. If this differentiation between the two terms is to be accepted, my own case would have to be reported as complete torsion with obstruction rather than volvulus.

The factors most usually associated by different authors with either of these conditions are gastropexy, great mobility of the stomach, an abnormal elongation of the lesser omentum, an exaggerated filling of the stomach with gaseous distention, a physical effort or fall, with increase of abdominal tension, repeated violent vomiting, partial and limited contraction of the different layers of the gastric wall, or any neighboring disturbance which pushes the greater curvature upward and to the right and the stomach out of place. Gas in the colon may be an important factor of the last type. The accumulation of air in the splenic angle of the colon acting directly on the stomach and by pressure on its vertical part may start a volvulus or torsion which, according to conditions, may be partial or total. Torsion to a lesser degree is not infrequent, and since there are no acute symptoms, may pass unperceived.

The pylorus has not the same fixity as the cardia and more easily permits complete rotation from below, upward, or toward the cardia. The only structure that offers any particular resistance is the phrenogastric ligament which, however, does not seriously hamper movement of the

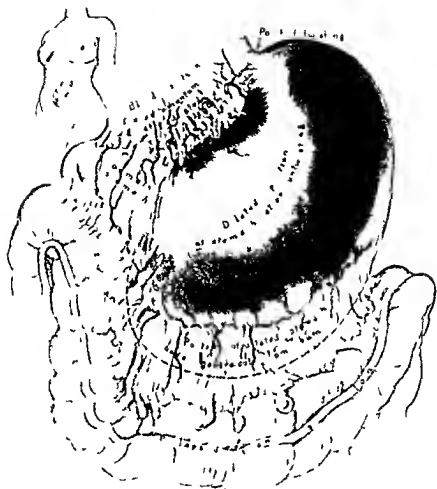


Fig. 1

greater curvature on the axis of the lesser curvature, which is the usual axis of twisting when traction is sufficiently strong. After a certain amount of rotation the mobile pylorus may come into contact with the cardia.

Kocher thinks that the immediate cause is overfilling of the stomach. The mechanical torsion is caused by movements of the body and by vomiting owing perhaps to the weight of the distended, displaced organ.

Twisting is more likely to result when the stomach is bilocular as in the case of ulcer or tumor. Many reported cases of partial volvulus are of this type.

The factor which has been mentioned by several of the German writers on this subject, as contributing to the occurrence of volvulus of the stomach, is constitutional weakness of the left half of the diaphragm. In Laewen's patient this was found to be the case.

Choisy and Babrantz in their own case of intermittent volvulus could find no other causal factor than intestinal distention which was coincident with the observed twisting and disappeared with it. This seemed to be the factor in my case.

In total volvulus or torsion when the abdomen is opened the posterior wall of the stomach presents itself covered by the mesocolon. The stomach orifices are twisted and occluded. The distended viscus appears as an enormous, congested, discolored, cystic tumor bulging into the abdominal incision.

The transverse colon, spleen and pancreas may be greatly displaced or even twisted with the stomach. The transverse colon may take a vertical position. The greater and lesser omentum are usually involved and may rupture with a blood effusion into the peritoneal cavity.

In partial volvulus the pyloric part of the stomach is usually twisted. In some cases the

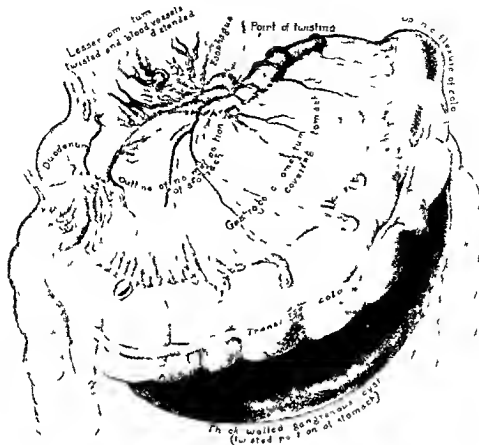


Fig 2

pyloric and cardiac parts may twist in different directions. Koppenstein's and Nockold's cases are examples of this type.

As a general rule the circulation is not greatly disturbed and the blood supply of the stomach appears to be more or less resistant to the torsion. In my own case strangulation of the vessels supplying the stomach was a very notable feature and even after reduction the circulation was not restored. Although I have looked into the literature carefully, I have not been able to find a case which presented such an extreme interference with the blood supply.

If death or operation does not cut the process short, it usually ends in perforation of the stomach wall by fissure or rupture due to extreme stretching from distention. If there is a weak spot in the wall, rupture is likely to occur there and in 2 cases such perforations occurred in ulcerous areas. In Helsinger's case the serosa was found ruptured in several places.

There are no pathognomonic symptoms of volvulus or torsion of the stomach. Usually true volvulus or complete torsion presents a sudden onset with rapid evolution of symptoms. There

is acute epigastric pain, retching, absence of peristaltic movements, rapid pulse, temperature not high, and perhaps cyanosis of the face. The general symptomatology is usually that of a high occlusion or of a perforated ulcer.

Very few cases of volvulus of the stomach have been diagnosed as such pre-operatively. The most usual diagnoses are ileus, pancreatitis, strangulated ovarian cyst, perforated ulcer, etc. In a few cases, such as those of Choisy and Babianetz and others, the diagnosis was made by X-ray investigation.

Siegel states that in his case the diagnosis was evident, as after lavage of the stomach and with drawal of a large quantity of fluid, the original distention reappeared after a few hours.

Pilcher says that there should never be any difficulty in immediately diagnosing the condition whenever there is vomiting which suddenly stops and is followed by an immediate increase in distention as the result of the production of gas due to a changed chemical reaction in the stomach.

The symptoms arising from acute volvulus or torsion call for immediate operative interference. After the abdomen is opened and the presence of

a volvulus is verified, the accepted treatment is puncture of the stomach, evacuation of gas and fluid detorsion, and gastropexy. This procedure applies when there is a true idiopathic volvulus but if the condition is rather a torsion due to a stenosis or some other condition, the pathological lesion should be treated according to the accepted methods. Fistulization may be indicated as a complementary operation.

In the case of early operation the prognosis is good. Of 28 cases collected by Kocher, 18 were operated upon and 13 recovered. Thorek's review showed that operation resulted in recovery in 60 per cent of the cases.

The case I wish to report is really one of almost complete torsion of the stomach. It is of interest because it presents an unusual condition. There was a complete interference, with stoppage of the blood supply to the organ which resulted in the patient's death. The history of the case is as follows:

A housewife aged 63 years was found lying in bed complaining bitterly of severe general abdominal pain. She stated that the day before following an unusually heavy meal she began to have a slight discomfort in the abdomen localized on the left side in the upper quadrant. The pain increased and by night became quite severe. She vomited many times. The vomitus contained the food eaten at noon was sour but did not contain blood or coffee grounds. She then became suddenly greatly distended, the nausea continued but there was no more vomitus. Fluids taken were immediately returned. She was given a high enema but without results. The distention remained and it was necessary to siphon the fluid. She had always been well until her present trouble and did not remember ever having had attacks of indigestion. She had typhoid as a child but no other serious illnesses. There were no previous operations.

Physical examination disclosed a well developed elderly woman apparently desperately ill. Examination of the head was negative except for dry, parched tongue and anxious facial expression. The heart and lungs were negative. Pulse was 108, respiration 24. The abdomen was greatly distended and tympanic throughout except in the upper left quadrant where a large oval mass could be outlined. This was dull to percussion and the abdomen was extremely tender. Muscle spasm was marked. The blood picture was as follows: Hemoglobin 89 per cent

red blood cells 5,768,000 white blood cells 16,200 polymorphonuclear neutrophils 85 per cent. Urinalysis showed specific gravity, quantity not sufficient, albumin 2 plus, sugar negative, acetone 2 plus. Microscopic examination of the urine showed a few hyaline casts, an occasional finely granular cast and a few pus and blood cells.

Operation was advised and performed at once. The abdomen was opened by an upper left rectus incision. A large oval mass the size of a football presented itself and at first appeared to be a large strangulated high ovarian cyst. The wall of the cyst was dark and it was impossible to deliver it through the abdominal opening. A trocar was inserted and three quarts of brownish fluid aspirated. It was then possible to untwist the mass which was found to be a greatly dilated stomach, four-fifths of which was twisted upon itself. The blood supply was entirely obstructed and failed to return after reduction. As the patient's condition was desperate it was necessary to place a tube in the stomach to make a quick examination for other pathological lesions and immediately to close the wound. The patient died a short time later and unfortunately an autopsy was refused.

The hurried examination did not reveal any cause for the twisting. There was no pyloric obstruction, no adhesions and no tumor mass in the wall of the organ. The diaphragm was normal. The mechanics in this case are I believe similar to Kocher's idiosyncrasy—the rotation was caused by a greatly distended stomach due to overeating and to gas formation. The stomach was rotated during the act of vomiting.

Fortunately rough sketches were made of the condition at the time and I have had the artist make completed drawings.

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THE SURGICAL CORRECTION OF CLEFT LIP AND PALATE

ALBERT D. DAVIS, DDS, F.A.C.D., B.Sc., M.D., F.A.C.S., SAN FRANCISCO

From the Division of Plastic Surgery, Stanford University School of Medicine

THE great number of operative failures in the surgical treatment of congenital cleft lip and palate, estimated at 70 to 80 per cent, should arrest the attention of all surgeons and give cause for serious reflection. Many prominent surgeons have abandoned palatoplasty surgery because of the preponderance of such failures, and yet at the present time one still finds osteopathic surgeons, general surgeons, as well as dentists, devoting part of their time to the correction of these deformities. It is easily understood, therefore, how differences of opinion may arise as to time of operation, order of procedure, and technique to be employed. A review of the literature from different parts of the world seems to indicate that there is probably no other field of surgery in which such a variance of opinion exists. In the United States the surgeons are divided chiefly between those who are followers of Brophy and those who are opposed to his technique.

In England, the surgeons almost to a man, are opposed to the Brophy operation, even though the Lane operation is practically obsolete. Gaillard y Nogue, a Spanish stomatologist, disagrees with the Brophy technique and advocates the excision of the premaxillary bones, as did Mills and Humphrey. E. W. H. Groves, and others. Addison and Traynor, of England, advocate operation within the first to the third year, while Brophy advises early operation. Veau and Lascombe of Paris close only the anterior part of the cleft bones (as do many American surgeons), leaving the posterior part of the cleft without wiring. Other instances of disagreement might be cited but if it is admitted that anatomical normality and perfect function are the objects sought for, as well as esthetic appearance, there must be some fundamental laws by which these objects may be attained.

Congenital cleft palate is a deformity in which all of the normal tissues are present in the palate at birth, and although ununited, contain every essential necessary to produce anatomical and functional normality. Therefore, if the surgeon who attempts operation upon these defects realizes that he has enough, but only enough tissues with which to restore normality, every precaution should be taken to obtain that end. Fundamentally there is one law which is con-

stant—if the bony arch is cleft it must be united, prior to other operations. This holds true for either a unilateral or a bilateral cleft. While some surgeons do not follow this procedure, there are sufficient reasons to make it a fundamental starting point. From a surgical standpoint, the ununited bones are an ununited fracture, and should be so treated—approximated, contact surfaces freshened, compact bone removed, bleeding cancelled, bone should be placed in contact with bone, immobilized, and covered with mucoperiosteum. Mere approximation of the bony cleft without union is unsurgical, unscientific, and leaves a deformity which, even though considerably lessened, is not corrected.

Every cleft palate patient, whether operated upon or not, requires orthodontia. If bony union has not been attained, and expansion of the dental arch is necessary, the orthodontist finds that, in



Fig. 1. Plaster cast illustrating approximation of bony cleft without union. The lip has been closed over the approximated bones at the first operation. There is an oro nasal sinus under the lip. The soft palate has been pulled forward in an attempt to obtain closure at the expense of speech. The tuberosities are spread widely. Note the irregularity of the teeth in spite of the fact that no wires had been used in previous operations. Failures in this case were due to the fact that the bones were not united at the first operation. A greenstick fracture operation is necessary.



Fig. 2



Fig. 3



Fig. 4

Fig. 2 Case showing bony union obtained at expense of normal bony arch. Most of the premaxillary bone has been cut away. The lateral halves of the maxilla have been forced together in front into almost a V shape with a large space between. The tuberosities are widespread.

Figs. 3 and 4 Profile and front views of same patient as

in Figure 2 showing marked deformity present in spite of many operations. It will be necessary to resort to some form of prosthesis after lip surgery is finished. Failure occurred in this case because the fundamental principles of palatal surgery were either disregarded or were misunderstood.

spreading the arch, the clefts are increased at the expense of obtaining normal occlusion. Successfully operated upon a cleft bony arch presents no more of a problem for the orthodontist than do some of the non congenital deformities. Moreover, the entire ground work in restoring normal

ity for lip, nose and soft tissues of the palate depends on a perfectly united bony arch. A perfectly united bony arch may be so widely spread in the region of the tuberosities as to render the subsequent closure of the cleft soft tissues a very difficult operation. Thus spreading occurs often



Fig. 5



Fig. 6

Figs. 5 and 6 Tripartite type of cleft lip and palate with premaxillary protrusion before and after correction. At the first operation a united well rounded bony arch was formed. Six weeks later the lip was closed. The nose may have to be raised later.



Fig. 7



Fig. 8

Fig. 7 Large cleft of soft tissues unoperated upon previously. The lip was closed in infancy. Note wide flat alveolus on right. Also irregularity of teeth.

Fig. 8 Same patient as shown in Figure 7 after palate operation.



Figs 9 and 10 Roentgenograms of cleft palate child 8 years old who had had several operations since birth. The lip was closed 24 hours after birth. The bones were approximated but not united. Attempts made to close

the soft tissues resulted in failures. In order to obtain a normal bony arch a greenstick fracture operation was done (Fig 10), and the freshened edges of the bony cleft held in place with silver wire.

times as a result of the use, as a retainer, of a single wire suture through the anterior part of the cleft bones. The malar processes act as pivots when leverage is exerted on the lateral parts of the cleft maxillæ, and as the anterior parts of the maxillary bones are drawn together, the posterior ends move apart. Unless this separation posteriorly is guarded against, the end result will be a short, tense, soft palate with which normal speech cannot be attained. In order to overcome this difficulty, the maxillæ are wired high up above the alveolar ridges both posteriorly and anteriorly. Upon this important step depends the success of the soft tissue operation. In 1884, Dr Brophy used a steel clamp for the mechanical approximation of maxillary clefts. This was discarded a few years later. Hammond and Roberts then came out with a modification of the Brophy clamp and were followed by other mechanical devices for causing pressure on the cleft bones. The lightest of such devices is one designed by Fox, a dentist, and consists of an adjustable bow to which are attached three pronged pads, one for each buccal surface and one for the labial end of the long side of the palate. By tightening the set screws and the gradual pressure of the attached spring, approximation is gradually obtained. The elimination of shock, dietary upsets, and other complications, is claimed for these methods. Wiring, however, is used by the majority of operators. To repeat, there must be provided a well rounded, united bony arch with tuberosities held in normal positions if the operations which follow are to be successful.

Observations made over a long period of years indicate that the greatest number of failures in cleft lip and palatal surgery are in those cases in which there has been failure in the primary operation. If it is considered that an infant at birth has only 50 per cent of the calcium deposits in the jaws, it is easily conceived how the cleft bones by digital manipulation, may be bent and moved to position before wiring. (This may be accomplished up to, and including the sixth month of age.) After this time it is usually necessary to place the wires in position, move the



Fig 11 left A patient with normal lip but cleft of soft palate. Note the deformity of the right ala. There was no cleft in the maxillæ.

Fig 12 Same case as in Figure 11 showing the large oropharyngeal opening. This child's speech is defective due to his inability to close the postpharyngeal space although the soft palate operation was done prior to speech development. It will be necessary in this case to lengthen the palate and institute speech training.



Fig 13

Fig 13 Diagrammatic drawing showing short closed soft palate. Note large pharyngeal opening. Correct speech can never be accomplished unless the palate is sufficiently lengthened so that the patient is able to close off the postpharyngeal space in forming consonant sounds.

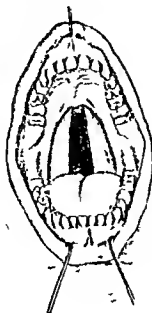


Fig 14

Fig 14 Same as in Figure 13 with the patient pronouncing the word 'ah'. Note the palato-pharyngeal muscles in contraction.



Fig 15

Fig 15 Shows operation for lengthening palate complete. Two-thirds of the palato-pharyngeal muscles are used to lengthen palate. Brophy operation.

bones as closely together as possible, and at various intervals tighten the wires until the bones are in apposition when flaps are made, the edges freshened, and union takes place. The preferable time for the Brophy bone operation is usually about the sixth week. At that time the mucoperiosteum (which must be raised and made into flaps) is far enough advanced to warrant successful surgery. The use of large bone pressure forceps upon the lateral alveolar ridges to produce

greenstick fractures in early infancy cases is unnecessary. Greenstick fractures are often made in late cases to obtain bony union. This is done by clinseling through the outer alveolar plate rather than with pressure forceps.

It is not difficult to conceive of the errors which may occur in the bone operation. With differences of opinion as to technique, desired end result, and the varieties of clefts requiring bone operation, failures creep in even when the services of trained surgeons are available. Time of operation is most important. If the bone operation is done in early infancy, three great benefits



Fig 16 Plaster casts of boy aged 18 years. A shows condition of palate prior to Brophy lengthening operation. B shows result obtained by utilizing two-thirds of palato-pharyngeal muscles. A long flexible palate was obtained.



Fig 17 Plaster casts of girl aged 20. A prior to lengthening palate. B, after operation.



Fig 18 Case of "inoperable" palate. History shows many attempts at closure with failure. Dense scar tissue with actual loss of tissue due to sloughing. Patient insisted on attempt to close palatal tissues. The series of illustrations (Figs 19, 20, 21, and 22) show what was done in this case.

accrue (1) less surgical risk, because of underdeveloped nervous system, (2) easier closure, because of limited ossification of bones, and (3) better results, because of establishing normal foundation for lip, nose, and soft tissues of the palate. These facts being admitted, bone operations in early infancy are imperative for future results. A pediatrician, cognizant of the importance of this work, is uniformly employed in



Fig 21, left Pedicle detached from hand receiving blood supply from the undersurface of the lip.

Fig 22 Pedicle attached to posterior part of palate. Since this series was taken the pedicle has been opened up and attached on both sides of the cleft. There remain a few slight 'trimming' operations prior to finishing.

the pre operative and postoperative care of all infantile cases. Co operation between pediatrician and surgeon is of the utmost importance. Higher mortality rates are practically invariable among those surgeons who do not employ the services of a pediatrician.

Routine roentgen-ray examination of the thymus gland should be made in all cases, prior to subjecting the patient to anesthesia. Henske reports a series of 54 cases, 11 of which showed definite thymus enlargement. Peterson and Miller report that 40 to 50 per cent of newborn infants have enlargement of the thymus gland. Early



Fig 19 Tubed pedicle which has been formed on abdomen.



Fig 20 Transfer of pedicle to mouth by utilizing the arm as a "carrier."



Fig. 23



Fig. 24



Fig. 25

FIGS. 23-25 This series of photographs presents a case in which the operators were overzealous in the removal of scar tissue from the upper lip with the result shown in Figure 23. It was necessary to transfer a large triangular

flap from the lower lip to the upper in order to obtain any degree of normality (Fig. 24). Figure 25 shows the profile obtained by the operation.

hospitalization with a definite course and technique of feeding is an essential in obtaining the best results. Isolation for 2 to 3 weeks prior to operation prevents the dangers of childhood disease.

Following the bone operation the lip is closed. While the lip may be done at any time the preferable time is from 6 to 10 weeks later. The important fundamental principles underlying lip surgery are (1) obtaining the correct flaps (2) obtaining fullness in the center (3) shaping the nose (4) avoiding scar, and (5) relieving tension.

Too much stress cannot be laid on the formation of the flaps in closing clefts of the lip. In the lip as well as in the palate, there are enough tissues present to obtain a normal lip but there is no excess. The lip, however, being flexible permits a latitude of excision comparable to few other tissues without interference with esthetics or function. Operations for the closure of the lip date back as far as the time of Celsus who lived in the period between 42 B.C. and 37 A.D. Various forms of lip flaps have been designed by surgeons since that time: Maligne, Dieffenbach, Neilton, Mirault, Owen, Koenig, Rose, Thompson, Ladd, Mayo, Simon, Brophy and others have outlined methods for the formation of flaps to close clefts of the lip.

Regardless of the design used, closure without obtaining normality is considered a failure. A certain degree of shrinkage must be expected. Broad flat surfaces must be used in approximation, and an equalization (in length) on both sides is necessary. The muscle elements of the

lip must be united so that the normal thickness is present when healing occurs. Of the various designs of flaps used practically all except the Brophy operation depend upon the sacrifice of some portion of the lip. Incisions carried around the ala of the nose or those which involve the cheek are impractical and usually unwarranted. Modification of the Mirault or Owen types of flaps are useful in some cases but if the nostril is involved they are faulty. In the Rose operation, crescent shaped masses of tissue are excised from each side. Thompson's operation is somewhat similar and requires the removal of considerable tissue. New's operation is a modification of the Thompson procedure. In experienced hands these operations allow harmonious relation with the lower lip but in many cases the angle to angle width of the lip is shortened, and the profile gives every appearance of a protrusion of the lower lip. Veru and Lascombe (Paris) excise equal parts of the upper quadrant of the lip and under portions of the ala extending their incisions around the ala on each side forming the prolabium into an irregular cone shape with definite angles. While similar in type to the Brophy operation, more of the lip and prolabium are sacrificed to attain the desired result. The same surgeons (Veau and Lascombe, Paris) convert the complete double clefts into partial clefts (at the same time the wires are placed through the bony cleft) by freshening the lateral sides of the prolabium and the lip and suturing leaving the lower edge of the prolabium untouched. Two months later the lip is closed, a modification of the double Owen operation being used. The

mucosa on the under surface of the prolábium is utilized in the formation of a lip lining. The Brophy operation utilizes practically all of the lip tissues. A small amount of skin and mucosa are sacrificed a short distance up in the nostril to allow the correction of the broad, flat nostril, and excision of redundant mucosa is made at the junction of the flaps below.

About 75 per cent of single clefts of the lip occur on the left side. The ala on the cleft side is flattened and provision for its correction must be made. Moreover, a floor must be provided for the nose, otherwise an oro-nasal sinus (so often seen) will result. Each case is a law unto itself which again complicates this type of surgery for the beginner, or for the surgeon who sees a few cases each year. The author has had cases of patients who have been operated upon previously 35, 24, 18, 14, 11, 9, and on down to 6 times with failure. Is it not time that a plea for a definite technique in cleft lip and palate surgery be made?

Most important of all the steps in cleft lip surgery is to secure a correct vermillion border. Too often the operator makes the lip longer than required for a good cosmetic result. Another common error is in the production of a notch in the lip at point of union of the flaps. When a superabundance of skin has been brought down to the median line, some of it must be removed to prevent skin and mucous membrane from being united. A fundamental rule, applying to all types of cleft lip, is that in suturing the flaps, skin must meet skin, and mucosa must meet mucosa. Skin flaps must be split in such a way that depression does not occur. Central fullness of the lip is obtained by properly shaping the flaps when cut. More mucosa is required on the "long" side in single clefts. The avoidance of tissue trauma, careful approximation, and relief of tension are fundamental in preventing scar formation. Vessels are taken up with tiny hemostats, with as little tissue crushed between the beaks as possible. Horsehair is the material of choice for sutures, and tension is relieved by the use of the Logan traction bow. Early removal of sutures (third to fifth day) prevents scarring, the bow being left in place until the tenth day.

Full consideration must be given to shaping the nostril in clefts of the lip. Whether the cleft be single or double, there is nearly always some involvement of the nares. Even when the cleft is incomplete, a ridge, a notch, a congenital scar, or a flattened ala are often seen, and it is necessary to produce temporarily a complete cleft in order to attain a result. Oro-nasal sinuses on

the under surface of the lip are due to failures in constructing a floor for the nostril involved. The mucosa must be united at the time of closure in order to avoid this error. Too often a flattened, malshaped nostril detracts from an otherwise perfect esthetic result. Correction of these defects vary according to type. Frequently an incision carried around the entire ala, undercutting in both directions and making a turn over subcutaneous flap, will raise the alar floor and distal margin to conform with the opposite side, after which the ala itself may be re-shaped. It is often necessary to remove or rearrange the lateral alar cartilage in order to overcome the depressed ala. Skin grafts are rarely necessary unless the deformity is so great that other methods fail. In selected cases, a Thiersch graft properly used gives form and contour to an otherwise hopeless deformity. Following a double cleft with marked protrusion of the premaxillary bones, raising the tip of the nose by the V-Y operation of Brophy, gives excellent results if strict attention to detail is paid. Nasal corrective operations are usually delayed until after the eighth year.

Clefts of the soft palate occur in twelve different types. In speaking of clefts of the soft palate reference is made to the soft tissues of the palate rather than to the velum alone. These clefts vary from a small cleft of the uvula to the extreme double clefts involving all of the soft parts from the uvula to and through the alveolar process on both sides. Closure of the minor clefts is comparatively simple. It is surprising to note, however, that a cleft involving only the uvula, if not operated upon prior to the time the child learns to speak, often results in a typical cleft palate speech defect, which can be corrected only by operation followed by speech training. When the cleft extends anterior to the horizontal plates of the palate bones and into the palatal processes of the maxillæ, many failures occur. The soft tissues comprising the covering of the hard palate and the velum itself are thin, flexible, and resilient. Due to the muscular action in speaking, breathing, swallowing, sucking, etc., and as a constant buffer for the tongue, these tissues are rarely at rest. For this reason, an operation, which closes the palatal defect perfectly at the time may break down due to the saw action of the lateral muscular flaps acting independently. Some form of splint must be used to prevent failure of union. This is best accomplished by the use of lead plates and silver wires as designed and used by Brophy since 1883. Not only do the plates and wires act as a splint to prevent movement but also to prevent the stitches from cutting out.

Moreover, the twisted ends of the wires bent down upon the plates are uncomfortable to the tongue and in the subsequent feedings the tongue will be prevented from coming into contact with the freshened edges of the palate to make suction. The proper use of these wires and plates places in the discard the use of temporary artificial palates and other devices for protection. It must be remembered that the use of lead plates and silver wires is not for the purpose of creating forceful approximation of the flaps. They should render inactive the muscular elements of the soft palate if properly placed, and allow relaxation of the tissues without resorting to lateral incisions in the palate. Silver wire No. 22 American gauge is used. These wires are inserted by drawing each through pilot sutures of braided silk. The posterior wire should pierce the tensor palati muscle, far back from the freshened edges and must not be twisted tightly enough to cut off the circulation and cause sloughing of the tissues.

Many surgeons feel that if by operation, closure of the cleft is obtained, a perfect result is assured. Unfortunately, this is not true. Closure may be secured oftentimes at the expense of the post pharyngeal opening which remains so large, due to shortening of the palate at the operation, that distortion in voice tone, articulation, and vocalization occurs. A complete shut off between the oral and nasal cavities must be made possible if perfect speech is to occur following cleft palate operations. The fricative and explosive sounds,—h, G, Sh, T, D, etc.—may be made only when it is possible to close off the oro-nasal cavity.

The factors entering into the formation of a soft palate which is long enough to function properly, which is free from excess scar tissue and therefore resilient and flexible, are within the reach of every surgeon. Careful attention to detail, time, and sequence of operations, proper foundation in preceding operations are the necessary requisites if a normal soft tissue operation is to result. When, following the soft tissue operation, the palate is short, tense, and bound down by scar tissue, it may be lengthened by the utilization of two thirds of each palatopharyngeal muscle and adding to the end of the palate, as designed by Brophy. By this operation the palate may be made long enough to close the postpharyngeal space, and by proper exercise and speech training the patient may learn to speak correctly.

The factors entering into perfect speech are a united soft palate, with its musculature intact, long enough to close the postpharyngeal space,

flexible enough to control the amount of air passing through the oro nasal communication, and resilient enough to allow normal nasal respiratory function. Dental prostheses to cover permanently the hard palate section of the soft tissues in order to obtain length in the posterior part are, to the author's mind, as poor a substitute for the use of the patient's own tissues as were the prostheses held in place by spectacle rims over the ears, for restoring defects in the face during the early part of the war. Most of the prosthetic devices in use could be discarded if properly planned operations were performed. Closure of secondary palatal defects in old, badly scarred cases presents a surgical problem which, although difficult, can be accomplished. The Ollier Thiersch, Wolfe, and Gillies tubed pedicle grafts have all been used successfully by the author in some otherwise hopelessly inoperable cases. Brophy's operations, using the French gliding flap method, have proved of advantage in smaller defects.

The successful closure of the three main types of major clefts involving the alveolar process is dependent upon primary bone union without spreading the tuberosities. Many times a closure may be obtained when the bones are merely approximated, but mere closure of the defect is a poor substitute for a long, flexible palate. Too many operators are content in palatal operations if the lateral parts of the palate are united. The result may be a tense, scarred, short, drumhead like palate incapable of function, and yet be united. While such a palate is in some respects better than the cleft, normal speech (which should be the prime object of the operation) can never be attained. When a normal bony arch has been formed, the cleft in the soft tissues is narrowed and lengthened and the ununited parts assume a position which allows them to unite without tension, distortion, or resorting to lateral incisions which may affect the blood and nerve supply. The lateral flaps must be raised by means of special periosteal elevators, from the midline of the fissure up near the gingival margins of the teeth and posteriorly as far back as the hamular process of the sphenoid on each side. Sometimes it is necessary to detach the hamular process entirely if the posterior part of the cleft is wide. When the flaps are properly elevated the former "U" shaped fissure becomes a "V". The edges of the cleft are then pared from the anterior part to and through the cleft azygos uvula. While this may seem of minor importance, the proper freshening of the cleft edges may mean the difference between success

and failure. Some surgeons attempt to split these edges with an incision parallel to the cleft, the knife passing between the nasal and the oral fold of mucosa. These edges tend to curl and, in splitting, islands of epithelial tissue are often unavoidably left, and when sutured, fail to unite, so that a defect occurs. It is much better to sacrifice a minimum amount of tissue with a direct through-and-through incision at right angles to the edge and thus insure a complete freshening of the entire length of the fissure. The wound is closed with horse-hair after the placement of the splint of silver wire and lead plates. Tension must be avoided both upon the horse-hair sutures and the splint. Unless the flaps are unusually thin, it is unnecessary to raise the mucoperiosteal flaps and to replace them in their beds a week or two prior to uniting them, in order to increase the blood supply. The patient is subjected to two anæsthetics, the flaps thicken and tend to curl, and the end result is a thickened, heavy soft palate in which lightness, resiliency, and freedom of movement are the requirements. A study of the normal palate will show no signs of massive thick flaps posteriorly, and the more nearly normal anatomical result attained the more nearly functional result will be reached. To prevent the child from injuring the palate and lip by getting the fingers up to the mouth, Brophy's cuffs are used. They are made of pasteboard, lined with cotton or sheet-wadding, and extend from wrist to a point midway between shoulder and elbow. When pinned on firmly and cross strapped with adhesive tape, free movement of the hand and shoulder is feasible but the elbow cannot be bent. They should be made to fit the wrist snugly so they cannot slip over the hand.

Feeding after operation is accomplished in the majority of cases by using a medicine dropper or rubber ear syringe, placing the milk on the back of the tongue and allowing time enough for swallowing without regurgitation. Irrigations of normal salt solution after feedings is important in operations involving the soft tissues of the palate. The Brophy nipple may be used prior to the bone operation, and the period between the time the lip operation is finished and the soft palate operation. Co operation between the parents and the pediatrician during the intervals between operations usually results in a better surgical risk for the patient.

SUMMARY

1 In the light of our present-day knowledge the proportionate number of failures in cleft lip and palate surgery is too high

2 A plea for a better understanding of the anatomy and functional activity of the palate is made

3 The fundamental value of the Brophy bone operation in early infancy cannot be overestimated

4 Failure of union results in (1) abnormal bony arch, (2) abnormal occlusion of teeth, (3) short tense soft palate and many failures of union, (4) imperfect speech as result of number three, (5) imperfect foundation for lip or soft palate operation, (6) imperfect foundation for orthodontic treatment, with probable increase in cleft bones if movement is attempted

5 Importance of time of operation and sequence of operations cannot be too greatly stressed

6 The spreading of the tuberosities when single wire sutures are placed causes (1) difficult approximation of the soft tissues, oftentimes necessitating the use of lateral incisions which are condemned, (2) mal occlusion of teeth, (3) operations to lengthen the palate in order that perfect speech (which is the goal of the soft tissue operation) may be obtained

7 Mere closure of the defect without anatomical and functional result is a poor substitute

8 The employment of a pediatrician has accounted for a decrease in mortality

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RADIUM IN THE TREATMENT OF CANCER OF THE VAGINA

IVAN DE RÖBEN, M.D., BUDAPEST, HUNGARY

Assistant Surgeon, First Gynecological Clinic, Royal Hungarian University Prof. Joseph Frigyes, Director

CANCER of the vagina is the most malignant and the most difficult to cure of cancers of the female genitalia. Fortunately primary vaginal cancer is rare, constituting but 2 per cent of the cancerous growths of the female genitalia. Secondary cancer of the vagina through extension from the surrounding organs is more frequent. It is almost impossible to distinguish the primary vaginal from the secondary growth, especially in advanced cases. Generally speaking, when the surrounding organs are free of cancerous growths but the vagina is involved, we can regard the case as a primary disease, in advanced cases the local extent of the growth serves us as a guide.

In our clinic in the 10 years between 1919 and 1929, of the 29 cases of primary vaginal cancer observed, 28 were treated with radiotherapy. This fairly large series of cases together with the fact that these patients were closely observed and supervised is the basis for the report of my experiences with radiotherapy in the treatment of this disease.

The patients are usually women past the climacteric, at a younger age cancer of the vagina is quite rare, although our youngest patient was 27 years of age, our oldest 71. As to the etiology, as in other cancerous growths we know little. It is hard to correlate its frequency with the number of births and abortions, as many patients observed were nulliparæ and uniparæ. In our series there were 4 nulliparæ, 6 uniparæ, and 19 multiparæ. Leucoplakia may be considered as a favorable soil for cancer, many regard it as a precancerous stage. Prolapse, prolonged irritation by a pessary, and cicatrices may help to produce cancer, but they cannot be regarded as the prime factors in causing the growth.

In the majority of cases the growth is located in the upper third of the posterior vaginal wall, this place being most exposed to traumata. It may also be located in the anterior or lateral vaginal walls. In our material the growth was located in 20 cases in the posterior, in 5 cases in the anterior, and in 4 cases in the lateral vaginal wall. There are two different types of vaginal cancer. The more frequent is a circumscribed tumor. In such cases the growth stands out like a mushroom, first with circular borders which become wider and wider extending into the slightly inflamed surrounding tissue and soon becoming ulcerated

forming a small crateriform excavation that is covered with yellowish putrid slough and bleeds freely on contact. The rarer type is the infiltrating growth which permeates between the many layers of the squamous epithelium. In this type usually the vagina becomes a rigid tube.

Histologically vaginal cancer presents the appearance of either a squamous celled cancer or, exceptionally, an adenocarcinoma. In all of our cases we found the squamous celled cancer, never adenocarcinoma. Vaginal cancer proliferates rapidly toward the perivaginal connective tissues and the surrounding organs—the rectum, the bladder, the cervix, and the parametrium. As the most frequent location of the growth is the posterior vaginal wall, the rectum is most exposed to metastasis, and when the anterior rectal wall becomes involved there is established a rectovaginal fistula with an uneven, infiltrated border. The bladder is not so often affected by metastasis. In the connective tissue the growth progress is unimpeded and follows no definite order. The spread of the cancer is aided mainly by the vaginal lymph vessels, through these it passes rapidly to the lymphatic glands, and there depending on the location of the primary growth metastases are formed in the inguinal glands if the lower third of the vagina is involved, in the hypogastric iliac as well as the sacral and rectovaginal perirectal glands when the upper two thirds is involved. Metastases to remote organs are not frequent.

The symptoms are similar to those of cancer of the cervix. At first there is a discharge, usually tinted by blood, next a hemorrhage which often is produced by coitus or vaginal douche. Pains appear late and indicate that the connective tissue has become involved in some extent. It is due to this absence of pains and disturbances in the early stages that patients come under observation only in advanced stages. Vaginal cancer grows rather rapidly and pregnancy favors its development. In the more advanced stages, when the rectum and bladder are also affected, tenesmus, obstipation, disturbances of micturition, and the appearances of fistulae will be the symptoms. When the pelvic bones become infiltrated the pains will increase. The general symptoms of the disease are loss of appetite, anæmia, and finally general cachexia.

As the general appearance of the vagina in the presence of cancer is very similar to that of senile

vaginitis, sarcoma, tuberculous ulcer, hard ulcer, and decubitus caused by pessary or foreign body, an excision and histological examination is absolutely essential in making a differential diagnosis.

The prognosis offers less hope than in cancer of any other of the female genitalia. The location of the growth, the complex lymphatic system of the vagina, the thin vaginal wall which scarcely protects its delicate surroundings, together with the fact that most of the cases come under observation only in the advanced stages, all contribute to the impairment of the prognosis.

In the treatment, surgery and radiotherapy may be practiced, but because of the nature of the tissue involved neither offers much hope, and the results are therefore unsatisfactory. The formerly used methods, excision of the affected portions, proved entirely unsatisfactory. Only the most radical operation may bring results. The radical operation aims at total extirpation of the entire genital tract and several different methods may be mentioned. Wertheim advises the abdominal, Schauta the vaginal, Olshausen the perineal, Fritsch and Kelly the sacral approach. If the cancer is in the upper third of the posterior vaginal wall, Kroenig believes that the rectum also should be resected. Combined and modified dorso-perineal extirpations were performed among others by Paunz, Pozsony, and Kubinyi. When the cancer is in the upper third of the posterior vaginal wall, Frigyesi combines total extirpation with resection of the rectum, preserving the sphincter function. If the cancer is in an incipient stage and the patient's general condition is good, removal is usually possible. It is unfortunate, however, that more than 50 per cent of cases come under observation when the cancer has reached so advanced a stage that radical operation is generally impracticable. Even after the most radical operations the results are bad, in addition to the high primary postoperative mortality in many instances, there is, after a short interval, recurrence in 90 per cent of the cases. Although cures have followed operation in a few cases, still the situation as to recovery from operation did not improve with the introduction of radical operation.

In our department 28 of the 29 cases observed were treated with radiotherapy, only one being operated upon. The patient, 40 years old, was found to have a hæmorrhagic, uneven, flat induration the size of a golf ball, in the posterior vaginal wall. The histological examination showed squamous celled cancer. Kubinyi performed a total extirpation according to the method of Kraske and Paunz. The patient died 3 months after the

operation. Section showed recurrence and metastases to the lymphatic glands.

Because of the difficulties and the poor results following the operative treatment of vaginal cancer, radiotherapy was greeted with hopeful expectations. Treatment with radium in the beginning in spite of the difficulties of its administration, proved very promising and the first observations apparently corroborated the favorable expectations. These great hopes were dampened, however, by statistics based on the 5 years' freedom from recurrence which is necessary to determine the efficacy of a method. A study of these proportionately few cases has shown that the improvement after radiotherapy is only transitory and that only in a small percentage is the prognosis improved.

The use of radium and the X-ray combined seems to be the most advisable means of treatment, that is, the growth is irradiated locally with radium, while the infiltrated lymphatic glands are exposed to the X-rays. Many difficulties are associated with the use of radium, for instance, the growth extends quickly through the thin vaginal walls and an incautious application of radium only stimulates the formation of rectal or vesical fistulæ. The radium tube must be kept at a proper distance from the rectum and bladder, and care must be taken that the tube is properly fastened in the vagina. To avoid complications the ray dosage must be determined with great care. Usually only small doses should be administered. To overcome the difficulties in the application of the radium tubes, many appliances have been constructed. The solid rubber pessaries made of different sizes and with small compartments for the radium tubes are the most practicable. These pessaries assure the proper distance between the tubes and the vaginal walls for the entire treatment of growths in any part of the vagina. Another means of application which has proved very suitable in many cases is a holder which is made of some moldable material shaped to the size and form of the vagina, which is provided with a thin rubber covering, and in which the radium tubes are embedded at proper places. This holder is placed in the vagina so that the radium tubes come exactly over the growths and it is fastened with silk ligature or plugging. Several other methods have been formulated to place the radium at the proper distance and to fasten the tubes in proper position.

In the tumorous type of vaginal cancer without involvement of the rectum or bladder, the implantation method may be used. Needles, small tubes, or thorium X sticks may be used. The

implantation method should be used only with the utmost care in cases properly selected. It should not be used in the infiltrated type of the disease. In such cases only tubes should be used.

X ray treatment alone is not sufficient. The X ray should be used only for the lymphatic glands. For the local treatment of the growth, radium should be used. In institutes with large quantities of radium the glands are exposed to *radium tele-irradiation*. After the surgical removal of vaginal cancer, radiotherapy is advisable as a prophylactic measure.

As cancer of the vagina is a rare disease, we have not sufficient data on which to base a final opinion as to the value of radiotherapy. Therefore our opinion must be based not on our experiences alone, but upon the few reports in the medical literature.

Cancers of the vagina are exposed to a single ray dose of radium of 1,000 to 2,400 milligram element hours. If the control examination shows an unsatisfactory result after 6 to 8 weeks the treatment is repeated according to the result obtained. The lymphatic glands are treated with X rays. Patients treated with radiotherapy are examined once every 6 weeks for a while, then once every 3 months and later once every 6 months. Those who do not present themselves for the control examinations are followed up by letters from time to time.

The results obtained in our cases most of which were observed in the advanced stages correspond to the results obtained by others as reported in the medical literature.

In the years 1919 to 1929 the First Gynecological Clinic of the Budapest University treated 28 cases of primary vaginal cancer with combined radium and X ray therapy. Of these 28 patients, 9 are still living: 1 after 9 years, 1 after 6, 1 after 4, 1 after 2, and 5 after less than 2 years. Of these, 2 patients can be regarded as cured, 1 free from recurrence after 9 years and the other after

6 years. Two lived 3 years, 1 lived 2, and 3 lived 1 year after the treatment, 12 died within the first year. One did not answer our repeated inquiries.

Of the 10 patients treated with radiotherapy by Gal at the Second Gynecological Clinic, 2 were free from recurrence for more than 5 years.

Of the 22 cases of Bumm treated with radium irradiation and observed for 3 to 6 years, 5 were successful. Adding these and Schaefer's cases to the cases treated at the Berlin Gynecological Clinic, in 1926 Philipp and Gonick reported 53 cases of vaginal cancer treated partly with radium, partly with combined radiotherapy. Of these 7 (13.2 per cent) were free from recurrence for more than 5 years.

Giesecke, of the Gynecological Clinic of Kiel, reported 3 cures in the 22 cases of vaginal cancer treated with radiotherapy.

Herman reports 2 recoveries in 16 patients treated with radium at the Royal Radium Institute of Stockholm.

Similar results were obtained by Bagg, Bayley, Cahen, Desporte, Franqu, Ikeda, Lehook, Semmelweis, Polubinski, Starry, and Wamekros.

The results obtained in the treatment of cancer of the vagina, whether by operation or by radiotherapy, are still far from satisfactory. The advantage of radiotherapy over surgery is that radiotherapy has a wider range of applicability also that at least temporarily its effect is palliative in most of the cases. The Wertheim method in patients who can be operated upon or total extirpation combined with the resection of rectum in cases with the growth in the posterior vaginal wall are considered to result in recovery most often. However, as in most of the cases of cancer of the vagina, radiotherapy is indispensable, it is reasonable to hope, that by perfecting the methods of treatment and the application of radium the results will not only be improved but the risk of recurrence will decrease.

INFILTRATION ANÆSTHESIA AND ITS USE IN FRACTURES

CARL O. RICE, M.D., MINNEAPOLIS, MINNESOTA

From the Department of Surgery, University of Minnesota

ALTHOUGH the use of local anæsthesia in fractures had its origin in 1885 when

Conway employed the method by injecting cocaine directly into the fracture gap, it has not become popular until recent years. It has been used by others more or less sporadically and only in a few cases. Among those pioneers are Reclus, Quenu, Braun (4), Dollinger, W. W. Jackson, Farr, Cumston, Fulton, Hagenbeck, Frostell, and Ira Cohen.

The prevailing opinion seems to have been that any injection into a broken bone or injured joint would be extremely likely to initiate an infection. But this erroneous idea has no sound basis if aseptic technique has been employed. Although he had not used it extensively in fractures, Braun (3) states that there should be no more reason for not injecting local anæsthesia into a fracture gap than in any other portion of the body. He was of the opinion that the danger from infection was very remote.

Nerve conduction anæsthesia for a fracture of the extremity was generally accepted with less skepticism and was employed to advantage by Keppler, Kulenkampff, Mueller, Mage, and Farr. But the skill required to produce nerve conduction anæsthesia usually prevents the general practitioner from employing this method very extensively. The inaccessibility of nerve trunks in certain areas, as in the hip, the shoulder, and the clavicle also make nerve block anæsthesia less desirable.

INDICATION

The only contra-indications to the use of local infiltration in fractures is the presence of an infection or a compound fracture. There may be other fractures where the use of local anæsthesia is not practicable, as in a fracture of the pelvis or a fracture of the spine, but these are not contra-indications for its use.

Relief of pain and relaxation of the muscles are the two main features to be accomplished with anæsthesia. The pain in a fracture arises largely from the torn periosteum and endosteum at the fracture gap. Surrounding muscles and muscle attachments are, no doubt, bruised and torn during the production of a fracture and thus cause pain. Allen states that bone and cartilage have no sensation but that the periosteum, endosteum, and synovial membrane are almost as sensitive as

the skin. He states that the bone marrow is also slightly sensitive.

With the employment of a general anæsthetic relaxation is not complete unless it is brought to the stage of surgical anæsthesia. This is sometimes difficult to accomplish with the administration of nitrous oxide or ethylene. On the other hand, relaxation of the muscles is possible under the influence of local anæsthesia, and this relaxation may be as satisfactory as under deep surgical anæsthesia. I have used procaine hydrochloride in an intracapsular fracture of the hip with relaxation so complete as to permit overcorrection of the fragments where under gas anæsthesia undercorrection is almost always the rule (Fig. 6).

It has been well expressed by Arthur E. Hertzler that "the difficulty encountered in the reduction of fractures is due to the muscle spasm produced reflexly by the injured tissues and when the damaged area is anæsthetized the spasm subsides." He considered it important to anæsthetize the periosteum at all points.

If a fracture is treated as an emergency, as should be done, the anæsthesia will be more effective in producing relief of pain and relaxation of the muscles, for at this time the surrounding tissues will not have become so swollen and tender and the greater pain will be complained of at the site of the fracture gap. If the fracture has persisted for several days it may be necessary to infiltrate some of the surrounding tissues and painful points before the effect of the anæsthetic will be complete. I have seen cases in which the fracture has been present for several days, immobilized in a pillow splint without reduction, supposedly waiting for the swelling to subside. In these cases the forearm or leg (as the case may be) is usually very markedly swollen from the finger tips to the elbow. The entire injured extremity is tender not so much as a direct result of the fracture but because of the swelling and œdema of the surrounding tissues.

These cases usually do not demonstrate the best results from the local infiltration, and it is evidently impossible to infiltrate the entire extremity with novocain. Supplementary medication with morphine or scopolamine in these cases is efficacious for it is usually these cases which require repeated trials at reduction and the aid of the fluoroscope. The anæsthetic effect begins within 5 minutes and is prolonged for at least one hour.

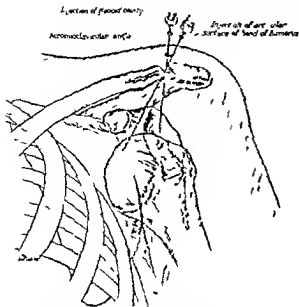


Fig. 1 Indicating the approach to the shoulder joint

This allows sufficient time for X-ray examination after reduction and remanipulation if necessary.

Hoehler has employed local infiltration in fractures for several years. He has used it in more than 2,000 cases with satisfactory results and without complications. No case of infection as a result of this procedure has been reported. No case of delayed healing has been attributable to this method of anesthesia. The theoretical production of a compound fracture by this method

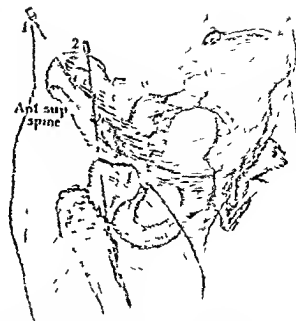


Fig. 2 Showing the approach to the hip joint for fractures of the hip

reduces itself to obscurity if ordinary aseptic precautions are observed.

PROCEDURE

It is noteworthy that no meticulous detail of technique is necessary in order to produce perfect anesthesia with this method. Infiltration into the fracture gap so that the torn edges of the periosteum and endosteum become impregnated with the anesthetic solution is usually all that is necessary to obtain local analgesia. Infiltration of the periosteum about the proximal fragment is not usually necessary, as has been suggested in an earlier article (23). It will, however, aid in those cases which have been delayed for several days.

The skin over the fracture is cleansed, then sterilized with iodine and alcohol and draped with sterile towels. A 1 per cent solution of procaine hydrochloride with 4 drops of adrenalin per ounce is used. The initial subcutaneous wheal is made directly over the fracture gap with a fine gauge hypodermic needle so as to minimize the pain as much as possible. This is then substituted by a longer fine gauge needle. Infiltration of the tissues is made slowly ahead of the needle, as it progresses to the fracture gap so as to alleviate the pain during the process of infiltration. The needle is not withdrawn until the infiltration is complete thus avoiding the possibility of contamination from repeated punctures. If the syringe must be refilled it is removed, leaving the needle in place.

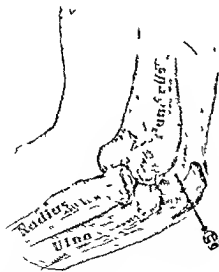
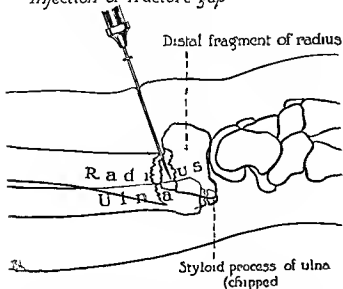


Fig. 3 The approach to a dislocation of the elbow or fracture of the olecranon

Injection of fracture gap

* Fig 4 Injection of fracture gap. The needle enters the fracture gap and bloody fluid can always be aspirated

When the fracture gap is entered, the required amount of procaine is injected. The position of the needle within the fracture gap can be identified by the ability to aspirate bloody fluid into the syringe. This blood has a cloudy appearance in contradistinction to arterial or venous blood, and does not indicate that novocain is being injected into the blood stream. It has always been possible to aspirate blood. This has been used as a criteria for determining the position of the needle within the fracture gap or in direct communication with it. No evidence of procaine poisoning has ever been observed. From 10 to 60 cubic centimeters may be required depending upon the size of the bone and the extensiveness of the injured tissue.

In previous papers (24, 25) certain points of entrance into the fracture or dislocation have been designated largely for the sake of convenience. These designations are arbitrary and have no direct bearing upon the result of the anaesthesia.

For a dislocation of the shoulder or fracture of the neck of the humerus, the approach is made

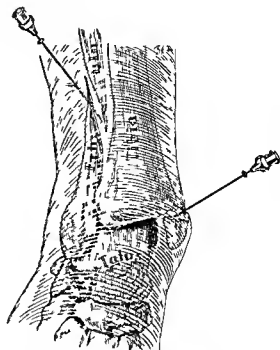


Fig 5 The injection of a fracture of the ankle

through a puncture at the anterior edge of the acromio-clavicular articulation, directing the needle very slightly medially and posteriorly so as to enter the joint capsule and the glenoid fossa, also rerouting the needle and directing it slightly anteriorly and medially to the disarticulated head still within the joint capsule (Fig 1). By using this fixed landmark the distortion of the shoulder will not lead one to an erroneous infiltration. Twenty cubic centimeters of procaine hydrochloride within the joint capsule should be sufficient to produce anaesthesia.

In an intracapsular fracture of the hip or dislocation the approach is made through a puncture



Fig 6 Fracture of the femur showing over correction. This was purposely done before the cast was completely fixed, to indicate the relaxation which is possible under local anaesthesia.

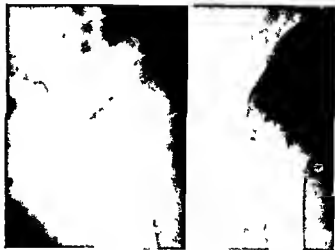


Fig 7 Fracture of the hip reduced under local anaesthesia. Before and after reduction.

at the lateral border of the anterior superior spine of the ilium (Fig 2). The needle is directed inward and slightly backward so as to pass along the lateral surface of the ilium over the brim of the acetabulum and into the joint capsule. This approach avoids important nerves or blood vessels and directs one accurately into the fracture gap regardless of the distortion of other landmarks. The anæsthetic solution diffuses into the fracture gap. Twenty cubic centimeters of procaine hydrochloride directly into the joint capsule usually suffices.

In a dislocation of the elbow the needle is inserted into the joint space from the lateral surface at the border of the palpable olecranon fossa (Fig 3).

For any of the superficial fractures where the bone ends are easily palpated as in a Colles or Pott's fracture or a fracture of the clavicle or phalanges, the needle is inserted directly into the fracture gap at its most superficial point. The anæsthetic solution will readily diffuse throughout the entire fracture. Gentle manipulation may facilitate this diffusion (Figs 4 and 5).

In a series of more than 200 cases observed or personally attended, I have seen no complications or sequelæ as a result of this method. One child, 7 years of age, refused to co-operate during the manipulation but was quieted immediately after the administration of a few breaths of nitrous oxide. A few others have been observed in whom the swelling and tenderness of the muscles failed to permit relaxation, but all these cases have been observed in unreduced fractures of more than 2 or 3 days' duration. I have used it in 10 intracapsular fractures of the hip with good results. In some of these cases soreness was observed along the thigh during the manipulation, but never sufficient to require general anæsthesia. Relaxation was all ways satisfactory.

SUMMARY

There are no untoward effects from the use of local anæsthesia in fractures. The simplicity of this method of anæsthesia makes it especially desirable. Better alignment of the bones can be accomplished because the fracture can be reduced with the aid of the fluoroscope if necessary and repeated adjustments may be made without further inconvenience to the patient. Relaxation of the muscles is accomplished satisfactorily. It does not interfere with the healing of fractures.

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HERNIOPLASTY—WATER INJECTION OF THE SAC TO FACILITATE ITS REMOVAL

SAMUEL ROBINSON, M D, F A C S, SANTA BARBARA, CALIFORNIA

From the Clinic of the Santa Barbara Cottage Hospital

IN the process of indirect inguinal hernia repair, the isolation of the sac and its separation from the cord is not infrequently an awkward performance. The cleavage is not a true one, the dissection is artificial, small veins are generally ruptured, an otherwise clean dry field becomes a wet one, the field is often "painted red," the tissues are less easily differentiated, trauma to the cord and injury to the vessels results not infrequently in swelling of the testicle and scrotum.

For the past 10 years the writer has employed a method of isolating the sac which is illustrated in the drawings (Figs 1, 2, 3). It is applicable only to reducible, indirect, inguinal hernias, complete or incomplete. It is not applicable in the removal of sacs less than 5 or 6 centimeters in length. Obviously it should not be employed if there is any indication of adherent bowel or omentum within the sac.

The cord is delivered in the usual way from the inguinal canal. A thin rubber tourniquet is applied with a single knot around the cord and neck of the sac at the internal ring. The Penrose drainage tubing is particularly suitable for the purpose (Fig 1). It has never produced any evidence of trauma to the cord structures. It should be tight enough to retain the sterile water later.

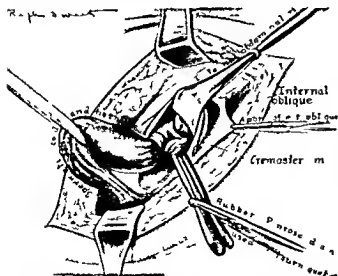


Fig 1 The spermatic cord with the attached hernia sac is delivered from the inguinal canal. A Penrose drain is placed as a tourniquet around the cord and the neck of the sac at the internal ring.

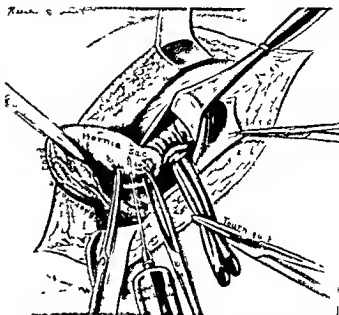


Fig 2 The side of the sac is picked up with Allis forceps. A syringe needle is inserted into the sac and sterile water is injected.

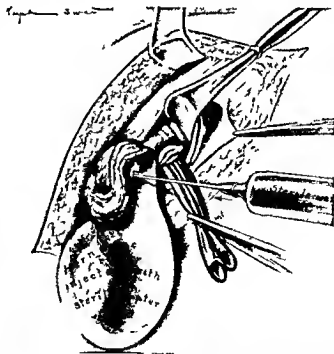


Fig 3 The sac is completely distended by the injection of water. In the distended state the sac has been dissected from the cord.

injected into the sac, not that any leakage into the peritoneal cavity is of any significance, but that such leakage prevents sufficient distention of the sac to facilitate the dissection.

On the posterior internal aspect of the cord it is not difficult to recognize the smooth, white tissue of the hernia sac. It should be picked up with thin bites of the two Allis forceps (Fig. 2). The syringe needle inserted into the sac between the forceps should not penetrate more than a few millimeters while the injection is started. If the sac is entered properly it will gradually distend under the pressure of the entering fluid. If the needle point is not accurately within the lumen of the sac an infiltration of the surrounding tissue will follow. This error is disclosed by the absence of an air bubble which is generally visible when the water is properly injected into the sac. The mistake is rarely made if the walls of the sac are well elevated before the needle is introduced. As the fluid enters the sac the forceps are removed, the needle is inserted to a more secure depth, and

is held in position by the thumb and forefinger thus preventing leakage around the needle. The injection should be carried on until the sac is distinctly tense, the greater the distention the easier the dissection. The needle is then withdrawn, a hæmostat being applied to the point of puncture. The separation of the sac from the cord by scissor spreading dissection then becomes a simple and satisfactory procedure without bleeding. The fundus is clearly defined, in cases of congenital hernia the relation of the sac is emphasized.

After the distended sac has been isolated completely from the fundus to the neck (Fig. 3), it is opened wide at the fundus, the water emptying into a basin. The tourniquet is removed, the sac transfixed and amputated, and the hernia repair continued.

Although it is the writer's impression that this technical point in hernioplasty has not previously been described, his apologies are nevertheless tendered herewith to anyone who may have done so.

SKELETAL DISTRACTION

DESCRIPTION OF APPARATUS

DAVID M. BOSWORTH, M.D., NEW YORK

THE literature is rather scant regarding the problem of the shortened extremity and more than scant regarding the lengthening of the offending bone or bones and soft structures. Refracture and manipulation of malunited bones to overcome shortening has been an inherited procedure attempted by many and successfully accomplished by few. A few millimeters occasionally have been gained but a return to normal length has rarely, if ever, been secured.

About 1905, however, Codivilla devised and advocated the use of skeletal traction as an answer to this problem, and so it has proved to be. Perhaps I should say he advocated skeletal fixation, for his calcaneal pin was to be used only to maintain length gained at the time of operation, and not to secure further extension. To quote him "I am convinced that in the extension of fleshy parts the best results are obtained from forced lengthening by using sudden and intense force and then applying plaster." In other words, he divided the bones, applied extreme force until no further length was gained, and then applied a plaster spica with steel side-pieces to maintain the calcaneal pin in extension. This process was repeated several times if necessary, about $\frac{3}{8}$ inch being gained each time. Freiberg reviewed Codivilla's work and again advocated his methods in 1912.

Magnuson, in 1908, 1911, and 1913, attacked this problem and advocated the division of the short bone, with immediate traction through hooks inserted in the cut bone ends, and the securing of the bone ends in the extended position by bone and ivory nails and screws. It is noteworthy that in these same articles he records the result of excellent work on the changes in, and absorption of, the inserted materials. The amount of extension gained remained about the same as that of Codivilla and Freiberg.

Taylor, in an article written in 1918, entitled "Shortening Long Legs and Lengthening Short Legs, a New Surgical Procedure" reported lengthening by the use of skin traction, with subsequent pinning of the bone fragments with tibial bone pegs. The greatest length secured by him was 2 centimeters. He advocated removal of a segment from the bone of the opposite side either in combination with the above or as supple-

mentary to it. Numerous workers have concurred with him in that the simplest procedure, heretofore, was to shorten the long extremity, among them Fassett. The latter also attempted lengthening the short bone, inserting blocks of magnesium or ivory between the separated bone ends to maintain extension. Skin traction also seems to have been used by him.

Putti, in an article published in *SURGERY, GYNECOLOGY AND OBSTETRICS* in 1912, first brought forth the principle of distraction. Traction implies the application of one force to the distal fragment of the bone to be lengthened and the opposing force indirectly upon the body or through the structures attached to the proximal fragment. Distraction implies the direct application of the separating forces to the two fragments of bone to be lengthened. His device, called the osteoton, consisted of a single extension member acting on pins driven into the bone fragments on both sides of a Z shaped osteotomy. His work was on the femur only and the results were extremely satisfactory, gains of 2 to 4 inches being secured. Others, working with his apparatus, have been unable to maintain the pins in place due to the action of the single extension member.

The operative lengthening of the long bones of the body was first placed on a uniformly successful basis in 1927, when Dr. Abbott, of St. Louis, presented an apparatus devised by himself and reported several cases of tibial lengthening. His article demonstrated beyond doubt that added length could be gained surely, safely, and easily. In this article he re-emphasized the principle I have called distraction and added a second extensive member to Putti's apparatus, thus obviating the slipping of the skeletal pins which had been so troublesome. He also emphasized the use of moderate, continuous force over a considerable period of time and the division of resistant unimportant soft tissue structures.

Since that time the literature on the subject is practically limited to an article by White, of South Carolina. In this Dr. White advocates the insertion of two pins above the area of tibia to be divided and two below, the division of the tibia in the usual tongue and groove or similar fashion, the application of a cast to include the

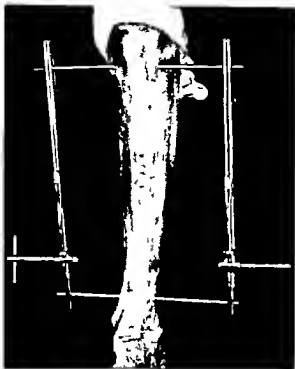


Fig 1 The present apparatus as applied by the two pin method to W B the first case herein reported

pins, circular division of the cast opposite the area of proposed tibial lengthening, and distraction of the two halves of the cast with their included pins and tibial fragments, by means of turnbuckles whose ends have been incorporated in the cast

I feel that some space should be devoted at this place to the description of Dr Abbott's apparatus, for the principles used by myself are his, and the apparatus herein presented differs from his original apparatus only in the method of securing extension and the greater ease of manufacture. Since this article in 1927, further refinements have been developed in the apparatus used at his clinic, until now, for simple operative lengthening of the tibia it supersedes both his original apparatus and that herein presented. For other uses, however, where distraction is necessary, as in the maintenance of a fracture, such as is shown later, the present apparatus is ideal.

The original Abbott apparatus consisted of two tubular sidebars with transverse holes in their ends which were slipped over pins driven through the extremities of the bones to be lengthened. Each sidebar was composed of a tube, into which fitted a rod. A cuff fastened about midway on the



Fig 2 The apparatus herein presented disassembled showing the tibial pins the drill used and the two sections of the Taylor hip traction splint drilled at one half inch intervals and used to secure extension



Fig 3 The special Thomas splint with turnbuckles from the lower rods to the pins for varying the position of the extensive apparatus and the relation of the fragments Adjustable footpiece shown

rod permitted the thrust of a coiled spring which could be compressed by a collar threaded on the tubular element. Rotation of the fragments could not be controlled by the apparatus *per se*, but was prevented by turnbuckles extending between a specially devised Thomas splint and the ends of the tibial pins.

In order to prevent this possibility of rotation, and to obviate the expense of a specially constructed apparatus, two sections were cut from the extensive portion of two old Taylor traction hip splints. Three sixteenth inch holes were drilled in the ends at half inch intervals. These were then substituted for the side pieces of Abbott. Ordinary drill steel, $\frac{3}{16}$ inch in diameter, was cut into pins 9 inches long and the ends rounded. These pins provide the spring action given by the coil springs of Abbott. They bend as the extensive force is increased and spring back as the soft structures give. Rustless steel has recently been used for these pins. A hand drill and a long $\frac{3}{16}$ inch steel drill complete the extraneous equipment (Fig 2).

The operative procedure used in the uncomplicated case of bone lengthening would not be varied from that described by Abbott. It consists in (1) Lengthening the Achilles tendon, (2) insertion of the pins, (3) osteotomy of the tibia and fibula, (4) application of the apparatus.

The usual pre operative preparation of the skin for bone cases is carried out. The tendon length



Fig 4

Fig 5

Fig 6

Fig 7

Fig 8

Fig 4 W B X ray pictures of the original condition with 1 3/4 inches shortening and solid union

Fig 5 W B X ray picture showing practically full lengthening and gap between bone ends

Fig 6 W B X ray picture showing maintenance of extension by one large bone chip and the presence of several smaller ones

Fig 7 W B X ray picture showing absorption taking place in bone chips prior to recalcification and ossification. Compare with Figure 6

Fig 8 W B X ray pictures showing condition one year after the first operation, with reappearance of medullary cavity. Slight anterior bowing, present by X ray, barely noticeable clinically

ening is done by the standard method of inverted L incisions, the cuts being directed either sagittally or transversely, so that continuity of tendon tissue is not lost, and then the tendon is lengthened an amount to correspond with the expected lengthening of the tibia. In inserting the tibial pins the steel drill is first passed through a hole in one of the side extension bars and then through a stab incision on the medial side of the leg at, or distal to, the tibial tuberosity. The skin should be retracted toward the center of the tibial shaft in making the stab incisions and drilling the holes to lessen the tension on them as the tibia is lengthened and the skin slides over the bone. The direction of the hole drilled in the tibia can then be controlled by the position of the sidebar. After the hole is drilled, a pin is inserted and the sidebar placed on the pin. Further holes in the distal end of the tibia and a second one in the proximal end may be drilled through the holes in the sidebar, using this as a guide to maintain their alignment. The sidebars are then placed on the pins. Through a single, long, curved anterolateral incision the midportion of the tibia is exposed. With motor saw, parallel vertical cuts are made on either side of the tibial crest, the saw scars slanting inward and backward. These cuts are joined below anteriorly and above posteriorly, providing a tongue and groove osteot-

omy. The crural fascia may be widely incised if necessary. After the wound is closed, vaseline gauze dressings are applied to the incision area around the pins. A tissue drain should be used for 48 hours.

Two, three, or four pins may be used at any desired interval, thus preventing anterior or posterior displacement of the fragments. Rotation is prevented by the construction of the sections of hip splints used for side extension bars. Lateral displacement is prevented by the transverse direction of the pins. The special Thomas splint with turnbuckles originally used to keep alignment and prevent anteroposterior displacement (Fig 3) may be discarded when three or four pins are used. If three pins are used, two should be in the proximal fragment and one in the distal. The distal fragment can then be controlled by varying the counterweight used to prevent the foot drop. The apparatus and leg may be suspended from a Bradford frame through cords attached to the pin ends. Foot drop is prevented by the foot piece on the special Thomas splint or by a counterweight attached to the Bradford frame.

Except where the apparatus is used in a fresh fracture, less than 3/8 inch lengthening will be gained at the time of operation. Extension of 1/8 inch every second day will be about the average.



Fig 9

Fig 10

Fig 11

Fig 9 J B Pre operative roentgenogram

Fig 10 Apparatus as applied to J B Note that alignment is maintained rotation prevented and the weight of the leg sustained without other appliances

Fig 11 J B Postoperative roentgenogram

increase practically independent of the force applied so that the side arms of the apparatus may be extended one notch on alternate days. Personally it would seem best that pin dressings be not changed until the pins were to be removed. The patient experiences practically no discomfort from the lengthening once the post-operative pain is gone.

CASE REPORTS

CASE 1: W B a young man aged 22 years was seen in my office January 8, 1929 with the left tibia and fibula short $1\frac{3}{4}$ inches and solidly united following a fracture 5 months before. Due to the condition present the usual tongue and groove method of tibial lengthening was impossible but operative lengthening was advised (Fig 4).

First operation: January 9, 1929 through a long curved anterolateral incision the left tibia and fibula were divided through the old fracture line and two pins were inserted one through the tibial tuberosity and the other through the distal third of the tibial crest (Fig 1). The apparatus reported above was applied and as only the two pin method was in use the appliance and extremity were put up in the modified Thomas splint. Less than $\frac{1}{4}$ inch lengthening could be secured at the time of operation with the bone ends visualized. The Achilles tendon and crural fascia were not lengthened or divided as compensatory shortening had not taken place in the former and the latter we believed would stretch. The incision was closed without drainage.

Postoperative course: The apparatus had been extended $\frac{3}{4}$ inch January 9 and no further extension was made until January 15, when $\frac{1}{4}$ inch extension was made.

During the next 17 days the apparatus was extended 11 times each time for $\frac{1}{4}$ inch only. On February 1 the pins were markedly bowed but no further length was being obtained. X-ray examination showed that the fibular fracture site had united and was preventing further extension. The fibular fracture site was therefore manipulated to break up the callus formation. Following the manipulation the appliance was lengthened $\frac{3}{4}$ inch on the morning at noon and on the afternoon of February 1, extension being easily gained. Late that evening measurements showed that the lengthening of the bones had proceeded $\frac{3}{4}$ inch during the day. The pins were slightly bowed. No further extension of the appliance was made yet due to the spring action of the steel pins lengthening continued and we were surprised to find a full 1 inch had been gained by February 3 (Fig 5).

Second operation: February 6 through a curved medial incision the gap between the ends of the tibial fragments was exposed and several cubic centimeters of clear reddish fluid evacuated. Fibrin and new fibrous tissue was removed from the bone ends with a curet. A large chip of the original fracture was removed and wedged vertically into notches cut in the tibial fragments. Numerous bone chips were cut from the tibial fragments and thrown loosely into the space between them. The soft tissues were closed in layers a silkworm gut drain being included in the center of the wound. The extension of the apparatus was then reduced $\frac{1}{4}$ inch, as only $1\frac{3}{4}$ inches lengthening was desired.

Postoperative course: Slight swelling was present the first postoperative day but had disappeared by the third day (Fig 6). The silkworm gut drain was removed on the fourth day. The sutures were removed and the wound found healed on the tenth day. March 13 the dressings about the pins were saturated with picric acid solution.

for 10 minutes and then the pins were cut with sterile rivet shears beneath the dressings, and removed. At this time they had been in place for 9 weeks, yet on removal they were not found loosened and the surrounding skin edges were clean and dry. No absorption could be made out in the pins themselves. The pin holes were closed and all crusts were off 21 days after the removal of the pins. Weightbearing without apparatus was permitted 6 months after the first operation and 1 year later the patient had no limp or foot deformity. There was slight anterior bowing of the bones of the leg as shown in Figure 7. Figure 7 compared with Figure 6 shows the decalcification which took place before the calcification and ossification commenced.

The only complication that arose was a small skin necrosis over the tuberosity of the os calcis which was easily closed with a pedicled full thickness graft from the opposite calf.

The following points are noteworthy in this case. The patient's age was 22 years, or several years older than any case reported in which the lengthening secured was comparable. The site of lengthening was at the point of junction of the distal third of the tibia with the proximal two thirds. This is the most frequent site for non-union of fractures, yet development of callus and ossification proceeded rather rapidly. The tongue and groove method of lengthening was impossible, but the rather large gap created filled in readily. The marrow cavity has already markedly replaced the newly formed bridge of bone (Fig. 8). Union and full weightbearing without protective apparatus was possible in 6 months. Full length has been maintained.

CASE 2. J. B. was seen on the ward of Broad Street Hospital November 12, 1929, 12 hours after being crushed by a large houlder. Examination revealed multiple fracture sites among them a compound comminuted fracture of the left tibia and fibula, $1\frac{1}{4}$ inches proximal to the ankle joint with over 2 inches shortening and marked displacement (Fig. 9). The line of skin laceration over the antero-medial surface of the distal end of the tibia was $5\frac{1}{2}$ inches long, exposing the underlying bone throughout. The accompanying fibular fracture was compounded through a second opening on the lateral side of the leg, as well as into the tibial wound. The left foot was cyanotic, cold, almost devoid of cutaneous sensory response, and tremendously swollen. Crepitation and abnormal mobility were present over the metatarsals, but due to the patient's condition no effort was made to secure an X-ray picture.

Operation. November 12, under light ether anesthesia, a $\frac{3}{8}$ inch hole was drilled through the neck of the left os calcis and a drill steel pin 9 inches long was driven into place. A similar pin was placed through the tibia just distal to the tuberosity. The side extension bars described above were placed on the ends of the pins and full extension to normal length easily secured (Fig. 10). Debridement of the tibial fracture site was carried out and the laceration and fracture site packed widely open with vaseline gauze. Sterile dry dressings were applied.

Postoperative course. Before the patient left the operating room, the circulation in the foot had improved a dusky red color obtained with the return of warmth to the skin. Portable X-rays taken the next day showed good alignment and extension (Fig. 11). On November 13 the pa-

tient was comfortable, with the leg and apparatus supported from a Bradford frame, allowing the patient free movement in bed, while retaining the leg fragments rigidly in position. The swelling of the foot was reduced 50 per cent and sensation and circulation were good. The condition of the tibial wound continued to improve in spite of the patient's general decline, the patient died of pneumonia 10 days after the injury. No autopsy was permitted but the pins were removed postmortem. No evidence of infection of the pin holes was found. They were so tightly seated they had to be driven out with a mallet.

It is unfortunate in reviewing the case that death occurred in the patient who might otherwise have obtained a good result insofar as the tibial fracture was concerned. The important point to bring out is that traction was imperative to save the foot. Skeletal traction was indispensable as skin traction could not be applied due to the distal location of the fracture and the already traumatized integument. Distraction by some device similar to that used was essential as the patient's position could not otherwise have been freely changed while the leg fragments were maintained in position. Had it been advisable, wet dressings or dakinization could have been carried out with the utmost facility, as the entire leg was readily accessible without the removal of the apparatus.

SUMMARY

An apparatus has been presented that is useful wherever skeletal distraction is indicated. It is simple, rigid, and easily made.

Two cases have been presented demonstrating the use of the appliance, where other methods would have been difficult or impossible.

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SPINAL ANÆSTHESIA IN ABDOMINAL SURGERY

LELAND S. MCKITTRICK, M.D., F.A.C.S. WILLIAM L. McCLURE, M.D.¹ AND
RICHARD H. SWEI T, M.D., BOSTON

From the East Surgical Service of the Massachusetts General Hospital

SATISFACTORY anæsthesia for a surgical operation within the abdomen requires a loss of the sensation of pain and sufficient muscular relaxation to permit the surgeon to perform the operation without loss of time and with a minimum of local trauma. If in addition to this, the anæsthesia can be safely induced without distressing symptoms to the patient, is of sufficient duration, and the drug employed is not toxic or irritating to such important viscera as heart, lungs, or kidneys, that anæsthetic approaches the ideal. There is much in the literature of the past 3 years to make one feel that the injection of a proper solution of procaine hydrochloride into the subarachnoid space more nearly approximates this than any other anæsthesia.

This investigation was undertaken without prejudice in an earnest desire to ascertain how closely this type of anæsthesia approaches the ideal and what part it might be expected to play in the surgery of a large general hospital. There were at least four questions which we hoped to answer:

1. What are the indications and contra-indications for its use?
2. What is the safest, easiest, and most dependable method of induction?
3. What are the advantages and disadvantages of this type of anæsthesia both to the patient and to the surgeon?
4. What is the effect of this type of anæsthesia upon postoperative complications?

METHOD OF STUDY

For the purposes of this study, only cases are considered in which the area of anæsthesia extended to or above the level of the umbilicus. In order that there might be a minimum of discrimination in the selection of patients, spinal anæsthesia was made routine for all abdominal operations on the East Surgical Service of the Massachusetts General Hospital for patients 45 years of age or over. The

period of study lasted for one year beginning October 1, 1928. There were, in addition, a number of patients in younger age groups in which spinal anæsthesia seemed desirable. With few exceptions all anæsthesias were administered by one of the authors. For purposes of control the West Surgical Service made no change in its routine nitrous oxide ether sequence except in a relatively few cases where spinal anæsthesia or nitrous oxide and oxygen seemed definitely indicated.

The East and West Surgical Services are of similar size. During this period many of the patients from the two services convalesced in the same wards. Patients are admitted to either service through the admitting office or emergency ward without any discrimination, every effort being made on the part of hospital authorities to maintain the two services as much alike as possible.

For the collection of data a special anæsthesia card was used for each case. The data during operation were noted by a student anæsthetist and during the postoperative period by one of us.

STATISTICAL DATA

Age and sex. There were 415 cases in all, of which 215 (52 per cent) were male and 200 (48 per cent) were female. The distribution of cases as to age is shown in Table I.

TABLE I—AGE BY DECADES

| Years | Cases |
|----------|-------|
| 1 to 9 | 0 |
| 10 to 19 | 11 |
| 20 to 29 | 43 |
| 30 to 39 | 67 |
| 40 to 49 | 62 |
| 50 to 59 | 106 |
| 60 to 69 | 73 |
| 70 to 79 | 20 |
| 80 | 1 |
| Total | 415 |

Types of operation. Operations for the repair of hernia led the list with 78 cases. Most of the operative procedures, however, were

¹Deceased.

within the abdomen, 9 other operations were included merely because the level of anæsthesia was high although the operations themselves were not abdominal (Table II)

TABLE II—TYPES OF OPERATIONS IN ORDER OF FREQUENCY

| | Cases |
|-------------------------------------------|-------|
| Repair of herniæ (all varieties) | 78 |
| Operations on gall bladder and bile ducts | 60 |
| Operations on colon and rectum | 58 |
| Operations on pelvic viscera (female) | 57 |
| Operations on stomach and duodenum | 54 |
| Appendectomies | 47 |
| Exploratory laparotomies | 25 |
| Operations on small intestine | 15 |
| Operations on lower extremities | 9 |
| Drainage of residual abscess (abdomen) | 4 |
| Splenectomies | 3 |
| Lumbar ganglionectomies | 2 |
| Operations on genito urinary tract | 2 |
| Laminectomy | 1 |
| Total | 415 |

PRE-OPERATIVE MEDICATION

Sufficient narcosis to relieve the patient of the mental strain of operation was deemed essential. The amount of medication necessary to obtain this is extremely variable, and there can be no dogmatic rule for either the kind or the amount of drug to be used. It was found that in young, healthy adults satisfactory results usually were obtained with $\frac{1}{6}$ grain morphine and $\frac{1}{200}$ grain scopolamin given $1\frac{1}{2}$ hours and again $\frac{1}{2}$ hour before operation. In elderly or weak patients, smaller doses were sufficient. In many of these it was found best to omit the scopolamin because of its tendency to produce delirium, a small dose of morphine being enough. In others it was unnecessary to give preliminary medication, the slightly depressing effects of the anæsthesia itself being sufficient to carry them along satisfactorily. Rarely, if ever, ought morphine to be given on the operating table for restlessness or discomfort. If anæsthesia is not entirely satisfactory, some form of supplementary anæsthesia is necessary but additional morphine ought not to be given in its place.

Ephedrine sulphate, 50 milligrams was given to each patient prior to the injection of the anæsthetic. In a few cases this was repeated during the course of operation if the

blood pressure fell to a point where some type of stimulation seemed indicated.

METHODS OF INDUCTION OF ANÆSTHESIA

Spinocain (Metz) as introduced by Pitkin was used first. The solution with a specific gravity of 1.005 is lighter than spinal fluid (1.007) and because of this the level to which it rises within the spinal canal can be more or less controlled, due to its viscosity it is said to produce anæsthesia of longer duration and more uniform than is obtained from other solutions. Although every effort was made to follow the technique as outlined by Dr Pitkin, there were occasional delays, and in one or two instances complete failure in obtaining a suitable level of anæsthesia. In one case there was complete absence of anæsthesia after two injections of the solution each containing 200 milligrams of procaine. Spinal fluid could be aspirated at the end of each injection, leaving little doubt but that the solution was put into the subarachnoid space. In view of the occasional uncertainty attending its use and the absence of sufficient compensating advantages, spinocain was used but 39 times in this series.¹

The heavy (glucose) solution first used by Barker and later advocated by Hepburn was then used in a series of 116 cases. This solution was obtained by dissolving 400 milligrams of procaine crystals in 4 cubic centimeters of a solution of 5 per cent glucose in sterile saline. With the patient in the lateral position the puncture was made in the third or fourth lumbar interspace, and without withdrawing any spinal fluid, from 1 to 3 cubic centimeters of the solution (100 to 300 milligrams of procaine) were injected. Following this, the head of the table was lowered to produce an angle of about 30 degrees for not more than 20 seconds. The table was then made horizontal and the level of anæsthesia tested. If it was not high enough, the head of the table was lowered a second time and if necessary a third time in order to get a satisfactory level of anæsthesia. After the desired level was obtained, the patient was left in horizontal position with the head and shoulders slightly

¹ Spinocain had been used in the hospital about 2 months prior to the beginning of this series.

elevated on a pillow. Great caution is necessary in using this method to avoid keeping the head down too long because the solution is heavy and will travel rapidly. The results with this method were reliable and satisfactory. It has nevertheless definite theoretical disadvantages. It involves the use of a glucose solution, the purity and sterility of which must be controlled. Furthermore the patient cannot be put into Trendelenburg position for at least 20 minutes after the induction of anesthesia.

The method finally adopted was the injection of a solution of procaine hydrochloride in the patient's spinal fluid, modified somewhat from the technique described by Labit. This method, described in detail below, proved most satisfactory because of its simplicity, safety, and uniformly good results.

The technique finally adopted is as follows:

Materials

- 1 No. 20 or No. 22 gauge, short beveled, flexible lumbar puncture needle
- 2 Small hypodermic needle
- 3 One 5 cubic centimeters and one 2 cubic centimeters glass syringe
- 4 Sterile water
- 5 Sterilized procaine hydrochloride crystals in ampules of stated dosage
- 6 Ephedrine, 50 milligrams for hypodermic injection
- 7 Procaine solution for skin anesthesia

Procedure

The needles and syringes are carefully flushed out with sterile water.

With the patient in the lateral position, a wide field in the lumbar region is prepared with 3½ per cent tincture of iodine and an intradermal wheal of 1 per cent procaine is made over the third or fourth interspace. Fifty milligrams of ephedrine are injected subcutaneously or intramuscularly.

The puncture is made through the intradermal wheal and about 2 cubic centimeters (see below) of spinal fluid are withdrawn with the 5 cubic centimeters syringe. *No spinal fluid is discarded.*

¹ Novocain (procaine hydrochloride—Mets) was used in this series. The sterile crystals may be obtained in ampules containing 50, 100 or 200 milligrams.

One hundred to 200 milligrams of procaine (never more than 250 milligrams) are dissolved in this fluid, diluted to about 4 cubic centimeters, and re-injected at about the speed of a hypodermic injection.

After a sterile dressing is applied over the site of puncture the patient is turned on his back and placed in 15 to 20 degrees Trendelenburg position with a low pillow under his head for comfort.

RESULTS

Level of anesthesia. In order to operate satisfactorily upon the stomach or gall bladder the level of skin anesthesia must be at or above the nipple line. It makes but little difference, so far as reaction of the patient is concerned, whether the level of anesthesia is at the xyphoid or whether it is at the jugular notch. Koster and Kasman making use of spinal anesthesia for operations on the head, neck, and upper extremities have shown without question the safety of the procaine spinal fluid method. It seems quite definite from their work that if the injection is given in the lower lumbar region and the dose of procaine is not too great, the concentration of the drug in the upper dorsal and cervical regions is not sufficiently high to cause a paralysis of the motor nerves supplying the diaphragm and intercostal muscles, and therefore the possibility of a paralysis of the accessory muscles of respiration is exceedingly remote. In view of this, it would seem to be of relatively little importance to have accurate control over the level of anesthesia if the operation is to be upon the abdomen. It is more important to make sure that the level of anesthesia is sufficiently high to carry out the operation undertaken. In the procaine spinal fluid method, it is easier to obtain a satisfactory level of anesthesia than it is to keep the anesthesia low. The more important factors which seem to influence the level of anesthesia and over which the operator has control are as follows:

- 1 The location of the puncture,
- 2 The force of injection,
- 3 The amount of fluid withdrawn and re-injected.

Roughly speaking, the higher the space the higher the anesthesia. Thus, using 200 milli-

TABLE III—A COMPARISON OF THE DURATION OF ANÆSTHESIA AS ESTIMATED BY THE NUMBER OF CASES IN WHICH SUPPLEMENTARY ANÆSTHESIA WAS USED

| Type of anæsthesia | Average dose in mgm of procaine | Duration of operation | | | | | |
|-----------------------------------------------------|---------------------------------|-----------------------|--------------------------------------|---------------|--------------------------------------|------------------|--------------------------------------|
| | | One hr or less | | One to 1½ hrs | | More than 1½ hrs | |
| | | No Cases | Supplementary anæsthesia No per cent | No Cases | Supplementary anæsthesia No per cent | No Cases | Supplementary anæsthesia No per cent |
| Spinocain (39 cases) | 300 | 20 | 1 (5) | 13 | 3 (23) | 6 | 0 |
| Procaine in 5 per cent glucose solution (116 cases) | 300 | 62 | 3 (4.8) | 29 | 4 (13.8) | 25 | 9 (36) |
| Procaine in spinal fluid (260 cases) | 200 | 117 | 6 (5.1) | 89 | 9 (10) | 54 | 20 (37) |

grams of procaine dissolved in 4 cubic centimeters of spinal fluid, 70 per cent of the cases in which the puncture was in the third lumbar space reached a level at or above the nipple line, whereas 66.6 per cent of the cases in which the puncture was made in the fourth space reached that level.

The force of injection, of course, varies with the individual. It is probably one of the most important factors in the so called knack of giving spinal anæsthesia, and undoubtedly does more than anything else to account for the difference in level of anæsthesia obtained by different men using the same technique. In general, the injection was made at about the same speed used for an ordinary hypodermic medication.

The amount of spinal fluid used to dissolve the procaine will determine, within certain limits, the level of anæsthesia. Our experience has been quite in keeping with that of Stout. Thus, when 2 cubic centimeters of spinal fluid were used to dissolve 200 milligrams of procaine, 31 per cent of the cases had anæsthesia up to or above the nipple line, with 3 cubic centimeters, 50 per cent, with 4 cubic centimeters, 72 per cent, and with 5 cubic centimeters, 87 per cent reached the same level.

The position of the patient on the table during and immediately following the administration of the anæsthesia has little if any influence on the level of anæsthesia in the procaine-spinal fluid method if the larger dilutions of spinal fluid are used. If, however, a concentrated solution such as 200 milligrams of procaine in 1½ cubic centimeters of spinal fluid is used the specific gravity of the solution will be distinctly higher than that of spinal

fluid. Therefore, if the patient is immediately turned on his back and hurriedly placed in high Trendelenburg position the solution will diffuse upward much more rapidly than if he remains in the horizontal position, and the level of anæsthesia will readily run up to a level high enough to permit any abdominal procedure. In the use of a special solution, however, such as spinocain or procaine in glucose solution the position of the patient during and immediately following the giving of the anæsthesia is of greatest importance. Sise collected 14 deaths following spinal anæsthesia in Boston due, in 4 cases, to the use of a light solution and the failure on the part of the administrator to realize the importance of keeping the head of the patient low. Regardless of what method of spinal anæsthesia is used, it will probably be impossible to change the level after 5 minutes.

Duration of anæsthesia. The duration of anæsthesia is variable (Table III) although the surgeon can usually depend upon an hour to an hour and 15 minutes of anæsthesia in the upper part of the abdomen. Two and four tenths (2.4) per cent of our cases required some type of supplementary anæsthesia during the first hour. In contradistinction to this, 66 per cent of 85 operations which lasted 1½ hours or more were completed without additional anæsthesia. Unknown factors as well as the amount of procaine used determine the duration of the anæsthesia obtained from subarachnoid block. Uncertainty and limitation of the period of anæsthesia are great disadvantages of this form of anæsthesia.

Supplementary anæsthesia. Ten and eight tenths per cent of our patients required some

form of general anesthesia for the completion of their operations (Table III). If, as occasionally happens, the level of anesthesia is too low to permit the surgeon to complete operation, some type of general narcosis is usually indicated. Failure to realize the care necessary in the administration of a general anesthetic to a patient with the operative field almost completely anesthetized may result seriously. It was the probable cause of a fatality in one of our cases before the present study was started. Ethylene oxygen, nitrous oxide-oxygen, or straight ether was used in our cases. The latter was found to be the simplest, the most effective and safest.

If, as more frequently happens, the effect of the procaine disappears before the operation can be finished, it is much safer to give a general anesthetic than when the patient is already partially anesthetized. If the operation itself has been completed the abdomen can always be closed by the injection of 1 per cent procaine locally. If a general anesthetic must be used, ether is by far the most satisfactory. It is exceedingly important however, that the ether be started at the first sign of returning sensation. This may be suggested by slight restlessness on the part of the patient, a change in the character of his breathing, or by a slight tightening of the abdominal muscles. If ether is started slowly at this point by a skilled anesthetist, the transition between the spinal anesthesia and the general narcosis of ether will be so gradual that it will not be recognized by the surgeon. If, on the other hand, the patient is allowed to go until he is definitely straining, the transition may be a very stormy one and may undo all the good effects of spinal anesthesia.

We have already suggested that morphine is not a substitute for general anesthesia under these circumstances and ought never to be used in the hope of avoiding it.

Nausea and vomiting during operation. Nausea and, less frequently, vomiting occurred in about 25 per cent of the patients during the course of anesthesia. These symptoms usually develop within 15 or 20 minutes after the injection of the procaine and subside after 5 to 10 minutes, although in a few instances they continue throughout the

operation. When present they seemed to parallel in point of time the maximum fall of the blood pressure. They may occur in any operation but are more common in operations on the gall bladder and stomach. In a few instances vomiting occurred before the introduction of the anesthetic and was probably due to the preliminary medication. The method used in the induction of anesthesia seemed to have no bearing upon the incidence. Not infrequently a series of deep inspirations on the part of the patient would ward off actual vomiting. If this was ineffective a few inhalations of carbon dioxide (25 per cent) mixed with oxygen (75 per cent) were frequently curative. Fortunately, when it did occur the relaxation of the abdominal muscles was so great that it was not as disturbing to the surgeon as it would have been with a patient under general anesthesia.

The abdominal relaxation obtained in a patient under spinal anesthesia is ideal. The abdominal muscles are completely paralyzed, the intestines contract, respirations are very quiet. There is no other anesthesia which gives such ideal working conditions within the abdomen. The surgeon is undoubtedly able to work with less local trauma, less soiling, and with greater facility than when working with any type of general anesthesia. All of these advantages, however, will be rapidly lost if the patient is permitted to have a return of sensation before the operation is finished and before some type of supplementary anesthesia is started.

Blood pressure changes during and following spinal anesthesia. In this series of cases the pulse, respirations, and systolic and diastolic blood pressure were recorded before the anesthetic was given and at 10-minute intervals during the course of the operation. In addition to this, postoperative pulse and blood pressure readings were recorded every half hour for 2 hours, and then every 2 hours until the pre-operative level was re-established or, at least, until a constant level was reached. The average duration of the postoperative period of observation was about 18 hours.

Analysis of cases with a fall of 50 per cent or more in blood pressure. A careful analysis was made of the group of 45 (10.8 per cent) of the

415 patients whose fall in systolic blood pressure during the operation was 50 per cent or more of the pre-operative level. The distribution of these 45 cases according to the method of anæsthesia was as follows

Spinocain, 10 cases, 25 per cent of all spinocain cases
Glucose solvent, 15 cases, 12.9 per cent of all glucose cases
Crystals and spinal fluid, 20 cases, 7.6 per cent of all crystal cases

Age Thirty-seven, or 82 per cent, of the 45 cases were 50 years of age or older whereas but 47 per cent of the entire series were in this age group. As a corollary to this observation it was noted that patients under twenty years of age rarely show more than a slight fall of blood pressure after spinal anæsthesia.

Sex Of this group, 31, or 69 per cent, were males whereas of the entire series 200 or 48.5 per cent were males.

Pre-operative medication No relation could be demonstrated between the degree of fall in blood pressure and the dosage or kind of drug used as preliminary medication.

Dosage of procaine The fall of blood pressure appeared to bear no relation to the amount of procaine used. There were wide variations in the degree of blood pressure changes in cases all of which had the same dose of anæsthetic.

Level of anæsthesia In this group of patients with 50 per cent or a greater fall in systolic pressure the level of anæsthesia was at or above the xyphoid process in each case. There was no apparent relation between the height of anæsthesia above this level and the percentage of blood pressure fall.

Pre-operative level of blood pressure In 10 cases (22 per cent) the pre-operative blood pressure was above 150 systolic. One case (2.2 per cent) had a pressure below 100 systolic. In the 10 cases with a pressure above 150 millimeters, there was no consistent correlation between the level of pre-operative pressure and the percentage fall.

Time after induction of anæsthesia when the maximum fall occurs The maximum fall in blood pressure usually occurred within the first 30 minutes after injection was made. This was true in 70 per cent of the 45 cases in the series whereas in 37 or 82 per cent of the cases the lowest blood pressure came within

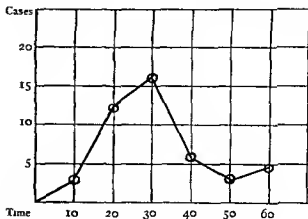


Fig. 1. Time after injection of anæsthetic when maximum fall in blood pressure occurs.

the first 40 minutes (Fig. 1). If the blood pressure continues to fall after the first 40 minutes, it is quite probable that there is some other factor at fault.

Time necessary for the restoration of blood pressure The blood pressure was followed for 20 hours after the patients returned to the wards. It is of interest and perhaps of considerable significance that in 25 per cent of these cases the pressure did not return to the pre-operative level during the period of observation, 22 per cent of the patients, on the other hand, did return to their pre-operative level of blood pressure within an hour after their return, and 59 per cent within the first 10 hours.

Complications following marked fall in blood pressure In Table IV are listed complications which occurred in this group of 45 patients where the fall in blood pressure was 50 per cent of the pre-operative level. Although it might have first appeared that the cause of death of several of these patients was related to spinal anæsthesia, a careful study of their records made this seem unlikely.

Effects of spinal anæsthesia upon patients with hypertension There is divergence of opinion as to whether or not high blood pressure represents an indication for, or a contra-indication to the use of spinal anæsthesia. In order to study our own results in these cases, those with a pre-operative systolic blood pressure of 150 millimeters of mercury or over were considered to have hypertension. We have arbitrarily selected 150 millimeters in order to include as large a number as possible.

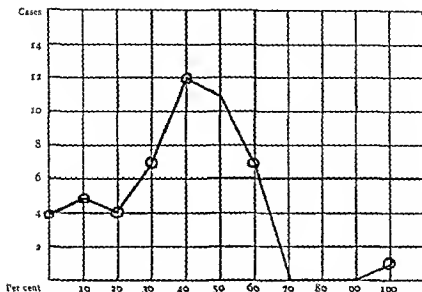


Fig. 2 Percentage of fall in systolic blood pressure in 50 hypertensive cases

Fifty (12 per cent) of the 415 cases could be placed in this group. The effect of spinal anesthesia upon the blood pressure of these patients is shown in Figure 2. In 18 per cent of these patients the systolic pressure fell 50 per cent or more, whereas in 64 per cent the fall was 40 per cent or less. In 32 of this group a careful record of their postoperative pressure was kept for a period of 20 hours. It is interesting to note that 47 per cent of these patients had not returned to the pre-operative level of blood pressure during the period of observation.

Only 9 patients in the entire series of 415 had a systolic pressure of 190 millimeters of mercury or more before operation. Of the 9 cases, 44 per cent had a drop in blood pressure which amounted to 50 per cent or more of the

pre-operative level (Table V). In one case, that of an old man of 80 years, the only patient in the series who did not receive a preliminary dose of ephedrine, a blood pressure reading could not be obtained after 25 minutes. In spite of this postoperative convalescence was entirely satisfactory. It is, obviously, impossible to draw any conclusions from so small a series as this. It seems fair to assume, however, that it is in this group that a marked fall in blood pressure might be expected to occur. It is also undoubtedly true that whereas one patient with a systolic pressure of 190 millimeters or more of mercury might tolerate a marked fall in blood pressure with little if any reaction, another patient may find it very difficult to readjust his circulatory balance after it had been affected by such a sudden and profound disturbance. It is possible that the ill effects to the patient with a marked hypertension comes, not so much on the operating table as in first few days of convalescence.

Postoperative complications in patients with hypertension. The lack of correlation between the fall in blood pressure and the occurrence of postoperative complications is not so obvious in this group as in the previous one (Compare Tables IV and VI).

*Effects of spinal anesthesia upon patients with hypotension.*¹ There were 33 patients with

TABLE IV.—POSTOPERATIVE COMPLICATIONS WHEN FALL IN BLOOD PRESSURE WAS 50 PER CENT OR MORE OF THE PRE-OPERATIVE LEVEL

| Postoperative complication | Number | Dead |
|----------------------------|----------|----------|
| Peritonitis | 3 | 3 |
| Pneumonia | 2 | 2 |
| Shock | 3 | 3 |
| Septicæmia | 1 | 1 |
| Intestinal obstruction | 1 | 1 |
| Cerebral thrombosis | 1 | 1 |
| Bronchitis | 1 | 0 |
| | <hr/> 12 | <hr/> 11 |

¹Not due to shock

TABLE V—BLOOD PRESSURE CHANGES IN 9 PATIENTS WITH A SYSTOLIC PRESSURE OF 190 MILLIMETERS OR MORE OF MERCURY BEFORE INDUCTION OF SPINAL ANÆSTHESIA

| Case No | Systolic pressure | Fall in pressure per cent | Time necessary to return to pre-operative level | Result |
|---------|-------------------|---------------------------|-------------------------------------------------|----------------------|
| 295705 | 220 | 18 | Not in 24 hrs | Recovered |
| 290712 | 190 | 11 | 6 hours | Recovered |
| 295669 | 210 | 45 | 20 hours | Recovered |
| 297846 | 210 | 45 | 10 hours | Recovered |
| 294695 | 195 | 25 | 2 hours | Recovered |
| 297247 | 200 | 100 | Not in 18 hours | Recovered |
| 300459 | 190 | 37 | 1 1/2 hrs (fall later) | Died pulmonary edema |
| 281990 | 210 | 59 | Not in 20 hrs | Recovered |
| 297942 | 190 | 55 | 2 hours | Recovered |

a pre operative systolic blood pressure of 100 millimeters of mercury or less. It is interesting to note that in 11 cases (33 per cent) the blood pressure rose instead of falling and that in only 5 cases (15 per cent) was there a fall in pressure of 50 per cent or more. As with those patients whose blood pressure was 150 millimeters or more, the maximum fall occurred in 68 per cent within the first 40 minutes. Quite in contrast with the hypertension group, however, is the time necessary for the blood pressure to return to the pre-operative level. Eighteen patients with hypotension were completely followed in this respect. Of this number all had either regained or exceeded the pre-operative level within 30 minutes after the operation was completed.

The effect of restorative measures on blood pressure after it has fallen. Efforts to restore blood pressure were resorted to infrequently. Table VII shows in detail those cases in which it was used and the method employed. It can be seen from this that our experience with epinephrine or adrenalin given after the fall in pressure occurred has been unsatisfactory. Intravenous injections of 500 to 750 cubic centimeters of 10 per cent glucose, however, were successful in every instance.

The effects of spinal anesthesia upon the respiratory system. Four cases in which respiratory embarrassment occurred are, it seems to us, of sufficient importance to warrant their report in detail.

CASE NO 296643, female, 45 years of age, presumably in good physical condition was given a preliminary narcotic consisting of 1/4 grain morphine and 1-100 grain scopolamine, 30 minutes before operation. Her blood pressure was 170-90. She had the usual pre-operative epinephrine, 50 milligrams subcutaneously, 300 milligrams of

TABLE VI—POSTOPERATIVE COMPLICATIONS OCCURRING IN 50 PATIENTS WHOSE PRE-OPERATIVE BLOOD PRESSURE WAS 150 MILLIMETERS OR MORE OF MERCURY

| Postoperative complication | Cases | Deceased |
|--------------------------------|-------|----------|
| Sudden death | 2 | 2 |
| Extensive sepsis | 1 | 1 |
| Peritonitis | 1 | 1 |
| Bronchopneumonia | 1 | |
| Melancholia* | 1 | |
| Irritation† | 1 | |
| Laryngitis | 1 | |
| Persistent vomiting (one week) | 1 | |
| Severe distension | 2 | |

*Involuntary melancholia (menopausal). Discharged to Psychopathic Hospital. Patient had an exacerbation after operation.

†Patient acquired from neurological service where he had been studied for similar episodes before.

TABLE VII—EFFECT OF RESTORATIVE MEASURES ON PATIENTS WITH PROFOUND FALL IN BLOOD PRESSURE FROM SPINAL ANÆSTHESIA

| Restorative measure | Cases |
|------------------------------------------------------|-------|
| Intravenous infusion of 10 per cent glucose, 8 cases | |
| Rapid rise in all | 8 |
| Epinephrine 2d dose 15 cases | |
| No change | 10 |
| Gradual rise (over 30 to 40 min) | 3 |
| Fall in blood pressure | 1 |
| Obscured by intravenous | 1 |
| Adrenalin, 8 cases | |
| No change | 3 |
| Gradual rise | 3 |
| Return to normal (30 min) | 1 |
| Fall | 1 |

procaine in 5 per cent glucose solution produced anesthesia to the mid sternum. The blood pressure fell within 30 minutes to 90-50. Coincident with this the patient became faint and cyanotic, the respirations were shallow and gasping, and the patient went into a comatose condition. High Trendelenburg position and carbon dioxide and oxygen inhalations resulted in complete recovery in 20 minutes. A cholecystectomy was done. Convalescence was uneventful.

CASE NO 297247, a colored man 80 years of age, entered the emergency ward with a tremendous strangulated inguinal hernia. He was not a good operative risk, his blood pressure was 200-100 and he was considered to have hypertensive heart disease. He was given 1/6 grain morphine 1/2 hour before operation. No epinephrine was given. Three hundred milligrams of procaine in 5 per cent glucose gave anesthesia to the costal margin. Within 20 minutes it was impossible to get his blood pressure, respirations became Cheynes Stokes in character, and he became unconscious. Respirations could always be stimulated by carbon dioxide and oxygen. He recovered satisfactorily in about 6 hours and his convalescence following that was uneventful. Although at the time it was considered unwise to lower his head because of the heavy solution it would undoubtedly have been safe and was definitely indicated.

CASE NO 301345 was a toxic, debilitated man of 50 years with an extensive ulcerative colitis. His preoperative blood pressure was 90-60. He was given no preliminary medication save the usual 50 milligrams of epinephrine

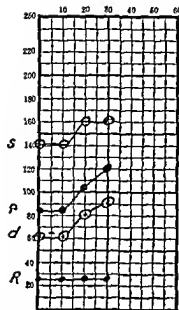


Fig. 3. Blood pressure (S, D), pulse (P) and respirations (R) to within few minutes of cessation of respirations in Case No. 300374.

Following the injection of 200 milligrams of procaine dissolved in 4 cubic centimeters of spinal fluid his blood pressure fell rapidly to 30-0 he became cyanotic perspired profusely and his respirations became shallow and irregular. He responded satisfactorily to Trendelenburg position, carbon dioxide and oxygen and intravenous glucose solution. He subsequently did well following ileostomy.

CASE No. 300374, an apparently healthy young woman of 42 years was to have a pelvic repair. Her pre-operative blood pressure was 140-60. Careful physical examination failed to reveal any definite physical handicap save for the fact that she was obese. There was no particular indication or contra indication to any type of anesthesia. Her pre-operative medication consisted of $\frac{1}{16}$ grain morphine and $\frac{1}{200}$ grain scopolamin $\frac{1}{2}$ hours and $\frac{1}{8}$ grain morphine and $\frac{1}{200}$ grain scopolamin $\frac{1}{2}$ hour before operation. Fifty milligrams of ephedrine sulphate were given subcutaneously just before the lumbar puncture was done. Three hundred and fifty milligrams of procaine crystals were dissolved in 3 cubic centimeters of spinal fluid and injected at the level of the third lumbar interspace. The patient was then placed in Trendelenburg position. She was attended by a nurse anesthetist who had just begun to learn to administer anesthetics. Thirty minutes after the injection her blood pressure was 160-90 millimeters of mercury her pulse 120 and her respirations 24 (Fig. 3). A few minutes later the surgeon, while doing an anterior colporrhaphy noted that the patient's blood was dark. Within 5 minutes of this time respirations ceased. The pulse was fair its rate not recorded. Artificial respirations were at once instituted with a bag containing carbon dioxide and oxygen over the face. Before the injection of intravenous glucose could be started the temporal pulse had disappeared and it became impossible to feel any apex impulse. After about 200 cubic centimeters of 10 per cent glucose with 10 minims of adrenalin chloride had been injected intravenously the pulse returned the patient's color improved, and the apex impulse became sufficiently marked

so that the person doing artificial respiration could readily feel it. After about 30 minutes of artificial respirations there were a few voluntary inspirations on the part of the patient but the pulse which had for a period of 15 minutes remained strikingly good gradually became weaker and after the first few inspirations disappeared. All further attempts at resuscitation failed although they were kept up for approximately an hour. Autopsy showed no obvious cause of death. Fluid withdrawn from the chest however, showed a recognizable trace of novocain $\frac{1}{2}$ hours after induction of anesthesia.

In the first three cases above, we believe that the respiratory complication was due to cerebral anemia. We believe this because of the improvement which occurred when the patient was placed in Trendelenburg position and because of the consistent response to carbon dioxide and oxygen regardless of the position the patient was in. We have seen these manifestations in cases not included in this series and the response to position and carbon dioxide and oxygen has been uniformly good.

Case No. 300374, however, represents what we believe to be a death due strictly to spinal anesthesia. Death in this instance is most satisfactorily explained by a paralysis of the accessory muscles of respiration. There is no end of evidence to show that the sensory nerves are much more susceptible to procaine than are the motor nerves and that procaine's insufficient concentration to cause a paralysis of motor nerves will give anesthesia. How wide this margin is we do not know. It is not unusual in high spinal anesthesia to see the respirations of the patient become very shallow due, apparently, to failure of all or a part of the intercostal muscles to function. Should it so happen that the procaine reaches the cervical region in sufficient concentration to cause a paralysis not only of the intercostal nerves but also of both phrenic nerves, paralysis of respiration would result not from any effect upon the respiratory center, but from mere inability on the part of the patient to breathe. In this case the sustained, in fact elevated, blood pressure until just before the patient stopped breathing and, in addition to this, the continuation of heart action beyond the time when respirations ceased are, we believe, evidence of confirmation of this interpretation. Under such conditions carbon dioxide and oxygen would be of no value until

TABLE VIII — ALL COMPLICATIONS IN ORDER OF FREQUENCY OCCURRING IN 338 PATIENTS AFTER OPERATION UNDER SPINAL ANÆSTHESIA

| | |
|--------------------------------------------------|----|
| Complications of respiratory system | 18 |
| Pneumonia, alone or with another complication | 10 |
| Bronchitis | 2 |
| Massive collapse of the lung | 2 |
| Pulmonary embolus | 1 |
| Pleurisy with effusion | 1 |
| Laryngitis and tracheitis | — |
| | 34 |
| Wound sepsis (minor 8 major 8) | 16 |
| Peritonitis (alone or with another complication) | 12 |
| Headache (slight, up to 48 hours) | 6 |
| Shock | 3 |
| Separation of wound (requiring suture) | 3 |
| Phlebitis | 2 |
| Cystitis and pyelitis | 2 |
| Decubitus ulcer | 1 |
| Intestinal obstruction | 1 |
| Cardiac decompensation | 1 |
| Cerebral thrombosis | 1 |
| Gastric fistula | 1 |
| Staphylococcus septicæmia | 1 |
| Total | 84 |

there was a return of function of the diaphragm. To be successful, resuscitative measures should be instituted coincident with or just before the complete cessation of respiration. It is quite possible that in this instance earlier institution of proper resuscitative measures might have prevented a fatal outcome.

RELATION OF SPINAL ANÆSTHESIA TO POSTOPERATIVE COMPLICATIONS

Complications due to spinal puncture. A careful study of the postoperative course and outcome in 338 of the 415 cases was made (Table VIII). Complications due to the spinal puncture itself were rare. There were no cases of meningitis or meningismus. Pain in the back or over the site of puncture occurred in a few cases but was never of any great consequence. Headache, often spoken of in the writings on this subject, occurred in only 6 cases and with but one exception it was very transient. In this instance it lasted for 48 hours.

Complications of the respiratory system. It was a great disappointment to find complications of the respiratory system account-

TABLE IX — COMPARISON OF COMPLICATIONS OF THE RESPIRATORY SYSTEM OCCURRING ON THE EAST AND WEST SURGICAL SERVICES OF THE MASSACHUSETTS GENERAL HOSPITAL

| | East Surgical Service (spinal year) | | West Surgical Service (either used mostly) | |
|---------------------------------|-------------------------------------------|-----------|--------------------------------------------------|------|
| | 10, 1928 | 10 8 1929 | 10 7 1928 | 10 9 |
| Pneumonia | 22 | 29 | 28 | 22 |
| Massive collapse | 15 | 5 | 1 | 4 |
| Pulmonary embolus | 0 | 5 | 7 | 4 |
| Bronchitis | 0 | 11 | 0 | 1 |
| Pleurisy | 1 | 2 | 1 | 1 |
| Upper respiratory in fection | 1 | 1 | 3 | 3 |
| Total | 39 | 53 | 40 | 37 |

ing for 40 per cent of those occurring in this series. It was hoped in this study to be able to confirm the opinion of others that spinal anesthesia has a marked influence on lowering the incidence of postoperative pulmonary infections. While it is true that in some instances this form of anesthesia was selected because of the presence of some pre-existing respiratory infection, and although the postoperative complications are probably more carefully recorded in this series of cases than in the hospital records, these facts alone would not account for the unfavorable comparison which the East Surgical Service (spinal) makes with the corresponding West Service (Table IX). It is also true that a large number of these patients were very poor operative risks, some were old, others debilitated by chronic disease, and a large number had advanced malignancy. It was nevertheless in these groups that it was hoped to lessen the incidence of pulmonary complications.

Of the 6 deaths from pneumonia, one occurred in a patient who had a pneumococcus upper respiratory infection with beginning pneumonia before he was operated upon for a perforated duodenal ulcer. A second was in a patient who had a sore throat.

Since the completion of the year required for this study a more careful consideration of the pulmonary conditions following operation suggests that many of the cases herein called "bronchitis" may best have been classified as atelectasis. The recent work (unpublished) of our colleague Dr. Donald S. King even suggests that the incidence of pulmonary atelectasis in patients who have had spinal anesthesia may be much higher than in those patients

TABLE \ — CAUSE OF DEATH IN 40 OF 338 PATIENTS OPERATED UPON UNDER SPINAL ANÆSTHESIA

| | |
|-------------------------------------------------|----|
| A Deaths from primary disease | |
| Acute cardiac failure (mistake in diagnosis) | 1 |
| Gastric hemorrhage from ulcer | 1 |
| Cirrhosis of the liver | 1 |
| Advanced peritonitis | 3 |
| Cerebral metastases from gastric carcinoma | 1 |
| | 7 |
| B Deaths from complications | |
| Pneumonia | 6 |
| Peritonitis | 3 |
| Peritonitis plus pneumonia (definite pneumonia) | 5 |
| Phthisis plus septic wound | 1 |
| Intestinal obstruction | 1 |
| Cerebral thrombosis (?) | 1 |
| Pulmonary embolus | 1 |
| Gastric fistula | 1 |
| Staphylococcus septicæmia | 1 |
| Cause unknown (? embolus) | 1 |
| | 26 |
| C Sudden Death—cause uncertain | 6 |
| D Death from anæsthesia | |
| Respiratory failure | 1 |

operated upon under inhalation anæsthesia. In the light of these results one would not be justified in choosing spinal anæsthesia with the expectation of preventing a pulmonary complication.

Deaths occurring in this series from all causes. Of the 338 patients whose outcome was carefully recorded there were 40 deaths, a mortality of 11.8 per cent. A classification of these according to cause is given in the accompanying table (Table \).

It is at once apparent that the majority of fatalities in the series could have had no connection with the type of anæsthesia. There were few deaths, however, which might bear some relation to the anæsthesia and therefore deserve brief mention.

There were 6 patients who died suddenly within 48 hours of operation, 4 of whom died almost exactly the same way. All of these patients were over 50 years of age. Only one had a systolic blood pressure of above 120 millimeters of mercury. Hers was 190—100. The manner of death is well illustrated by the latter patient who, having had a complete hysterectomy for carcinoma of the fundus, had been quite well until the evening of the second day. At this time, she began to have pain in the chest, her lungs filled up rapidly

with fluid, manifested by loud, moist rales everywhere over the chest, and she died within 12 hours apparently of acute pulmonary oedema. Three other patients died under very similar circumstances. Unfortunately, autopsy permission could not be obtained in any of these cases. It was thought that they died of circulatory collapse but the relation, if any, to the type of anæsthesia used is not clear. A fifth case died of shock and a sixth, in the last stage of cirrhosis of the liver, died of his primary disease. In no case was the fall in blood pressure during anæsthesia very remarkable. Two had a fall of somewhat more than 50 per cent. It is only fair to say that one of these patients had a 4 day, acute intestinal obstruction and was in rather a precarious condition, and that another had an advanced carcinoma of the stomach with extensive metastases. A third was an aged man who had a gastrostomy for cancer of the œsophagus. The end result in these 3 last patients therefore was not unexpected. Death, nevertheless, did come in a sudden and unexpected manner.

Postoperative pneumonia is usually regarded as a relatively benign disease, but of the 13 patients who developed this complication in this series 6 died—a mortality of 46 per cent. Two of the fatal cases were given ether and a third nitrous oxide and oxygen to supplement the spinal anæsthesia.

CONCLUSIONS

1 Spinal anæsthesia does not fulfill all of the requirements essential to the ideal anæsthetic for abdominal surgery. Nevertheless, it has an important place in surgery below the diaphragm.

2 The indications for and the contra-indications to its use are difficult to enumerate. It is safe in experienced hands. It is indicated in operations of an hour to an hour and fifteen minutes duration, in the presence of diabetes, tuberculosis, or where there is definite damage to kidneys or liver. It is indicated in long operations whenever it is desirable to spare the patient an hour or more of general anæsthesia. It is contra-indicated in perforations of the intestines because, through its effect on peristalsis intestinal contents may be emptied into the abdominal cavity. It is also

contra-indicated in a patient on the verge of collapse, in a patient where the nature of the condition contra-indicates the Trendelenburg position (general peritonitis), in any patient where a sudden fall in blood pressure might be hazardous, and for any operative procedure upon a very sick patient which can be successfully carried out under local anæsthesia

3 There is no evidence that hypertension *per se* is a contra-indication to spinal anæsthesia. It is nevertheless true that in patients with a systolic blood pressure of 190 millimeters or more of mercury, a fall of 50 per cent or more of this level frequently occurs and may result in temporary respiratory embarrassment. It is quite probable that spinal anæsthesia does little, if anything, to reduce the risk of abdominal operations in the group of patients with hypertension and arteriosclerosis and at times may increase it through a disturbance of their cardiovascular balance

4 Spinocain, procaine hydrochloride in 5 per cent glucose solution, and procaine hydrochloride crystals dissolved in the patient's spinal fluid were the methods used. Re-injection of a solution of procaine crystals in the spinal fluid is believed to be the safest, easiest, and most dependable method

5 The advantages of spinal anæsthesia are complete relaxation, quiet respirations, contracted intestines, a probable lack of direct irritation to kidneys, liver, and lungs, and the absence of any direct effect upon the metabolism of a patient with diabetes mellitus

6 The disadvantages of spinal anæsthesia are the short, uncertain period of anæsthesia, the uncertainty of its effect upon blood

pressure, occasional nausea and vomiting occurring during operation, and the slight handicap of working in the upper abdomen with the patient in Trendelenburg position

7 The effect of spinal anæsthesia on post-operative complications in a series of 338 unselected cases is a disappointment. During the year in which spinal anæsthesia was used on the East Surgical Service at the Massachusetts General Hospital, there was an apparent increase in the number of post-operative pulmonary complications over that of the preceding year and over that on the West Surgical Service which used the routine inhalation anæsthesia. While spinal anæsthesia is not irritating to the lungs and may lessen the incidence of postoperative complications when operation is necessary in young patients who already have an acute respiratory infection, there is no evidence at hand to show that spinal anæsthesia materially lessens the post-operative complications of the respiratory system in elderly and debilitated patients. An increase in the incidence of atelectasis which in turn may lead to more serious conditions is suggested as a possible explanation for this

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EDITORIALS

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APRIL, 1931

HOMEOSTASIS OF THE FLUID MATRIX AS AFFECTED BY EXTERO- FECTIVE AND INTEROEC- TIVE NERVOUS SYSTEMS

OUR bodies are composed of highly unstable material, so unstable indeed that only a few minutes of oxygen lack results in such profound decomposition of important parts that they cannot recover from it. In spite of this high degree of instability of the substance of our organization, the organization itself exhibits and preserves a marvelous stability. For example, what machine has ever been constructed which will maintain for three score years and more a temperature so uniform as that of human beings? It allows thermometer makers to put a "normal temperature" mark on their instruments which is serviceable in the Arctic circle and under tropical suns, and with peoples of all varieties of race and labor.

We commonly think of ourselves as air-inhabiting animals, but in fact we are separated from the air about us by dead stuff—by a layer of horny scales or by salty water and mucus. All that is living in our organization

lies within these dead surfaces and is bathed in the fluids of the body, the blood and lymph, which may be called the "internal environment" or *fluid matrix*. Claude Bernard the great French physiologist, showed keen insight when he pointed out that the constancy of the organism depended on the constancy of its internal environment. He clearly recognized that as organisms have evolved from less complex to more complex forms they have obtained gradually more and more control over the internal environment until its constancy in mammalian forms is highly perfected. The frog unable to control its body temperature, must hibernate in the mud during the winter. The mammal, with the same temperature surroundings for its living parts whether the outer atmosphere is cold or hot, is liberated from the vicissitudes of the external environment. As Bernard expressed it, "The fixity of the internal environment is the condition of free and independent life."

The fairly steady states of the internal environment—its fairly constant temperature, its only slightly variable hydrogen ion concentration, its regulated sugar content, its fixed osmotic pressure—might be called "equilibria," but that term has a definite significance in physicochemical states having a relatively simple character. The steady states in our bodies are maintained by highly indirect and complicated physiological reactions. So it seems desirable to designate the idea of constancy in living organisms by a special term, I have suggested the name, "homeostasis." It does not mean constancy in the sense of stagnation, but constancy, or relative constancy, in the sense of condition

Not only are changes in the outer world capable of disturbing the body fluids and consequently the internal environment, but the activities of the organism itself are continually bringing about alterations. When we run, we utilize blood sugar, we produce acid, we develop heat. All these changes, if continued to extremes, would result necessarily in lessened capacity to run. Before that stage of inefficiency has even threatened, reactions occur to protect the body against it. For example, a shift of the blood in the direction of an acid reaction, as a consequence of muscular exertion, is promptly met by a rise of blood pressure, a faster heart rate, a deeper breathing, all of which reactions are directed toward carriage of oxygen more rapidly and more abundantly to the parts where non-volatile lactic acid is being developed, so that it may be burned to volatile carbonic acid, and toward carriage of that volatile acid more rapidly and in larger volumes to the lungs to be disposed of.

A survey of the complex of reactions hinted at in the foregoing paragraphs leads to the functional separation of the nervous system into two main divisions. One of these is in control of skeletal muscle. By means of it we bring about all the marvelous changes in the outer world, from X-radiations to airplanes and sky-scrapers, that characterize our present civilization, or we alter our relations to that world. That is the *outward-working* portion, the "exteroceptive" division of the nervous system. As pointed out above, whenever we become active through use of the exteroceptive division, we change the *internal* environment. And unless this change is met by corrective measures, the fitness of the internal environment for continued action becomes impaired. It is at this stage that the other division of the nervous system comes into play—the *inward-working* portion or the

"interoceptive" division. The main part of this division, the part chiefly concerned with maintaining homeostasis, is the sympathetic system. It liberates sugar from the liver when the sugar level tends to fall. It discharges heat-producing adrenin, contracts the blood vessels and erects the hairs in cold weather. It causes secretion of sweat when the body temperature begins to rise. It produces the alterations in the heart rate and in the blood vessels, mentioned above, that are necessary for a faster circulation when non-volatile acid must be quickly burned to preserve the normal reaction of the blood.

The sympathetic system, therefore, is the main interoceptive agency controlling homeostasis. To it we owe our ability to continue our lives under uniform conditions, in spite of great variations of circumstances in the outer world and in spite of large chances of disaster from changes in the fluid matrix of the body. As recent experiments have shown, animals can be kept alive indefinitely with the sympathetic system eliminated from any possibility of functional use to the organism. But such animals must live in a practically uniform temperature, and must be freed from the necessity of struggle for food or safety. In losing the services of the sympathetic part of the interoceptive division of the nervous system, they have lost control of that "fixity of the internal environment" which "is the condition of free and independent life."

WALTER B. CANNON

SURGICAL PRINCIPLES

IT would be well for the surgeon and patient alike if the former had constantly in mind the fact that the human body is composed of delicate living cells. It matters little to the patient or to the relatives that a satisfactory operative procedure was completed, if the former succumbs as a result of the operation. It

is important, therefore, to evaluate properly the different features of the patient's condition and to treat him as an individual rather than as a case—in other words the operation should be planned and executed so as best to meet the needs of the individual patient.

In emergency cases it is often necessary to operate immediately regardless of minor contra indications, in order to save life. But there are not many conditions in which surgery is so urgently indicated that time may not be taken to give the patient a blood transfusion or to administer glucose intravenously or saline subcutaneously. Sometimes, as in acute abdominal catastrophes, it may be impossible to establish a correct pre-operative diagnosis—nor should valuable time be lost in such cases in an attempt to make an absolute diagnosis before operation. Here the surgeon must be satisfied with the decision that a surgical condition exists and that immediate operation is imperative. But in the average so called chronic case, a conscientious effort should be made to establish a correct diagnosis before operation. In this connection it is gratifying to observe that the term "exploratory laparotomy" is now seldom used.

The surgeon should make his own diagnosis or at least be sufficiently acquainted with the patient's condition to enable him conscientiously to agree or disagree with the diagnosis already made.

A factor contributing greatly to better operative results is the tendency of physicians and surgeons to emphasize more and more the importance of the pre-operative treatment of the patient. It is no longer considered good treatment to perform a major operation for a chronic ailment upon a patient admitted to the hospital the evening or night before without preliminary preparation and observation. It is illogical to expect a patient, who is toxic and dehydrated, to withstand an extensive

surgical procedure without suffering severely from shock. Adequate and carefully supervised pre-operative hospitalization for several days or more, if necessary, will always improve the patient's condition for surgery. Such pre-operative treatment followed by a well planned, carefully and dexterously executed operation will do much to simplify postoperative treatment and to insure a smooth convalescence.

Good surgery demands proper exposure, gentleness in handling tissues, careful hemostasis, and such speed as is consistent with satisfactory work. The surgeon should not sacrifice hemostasis and gentleness for speed but should gradually develop the kind of speed which results from dexterous, purposeful movements each of which counts. Excessive traction upon the abdominal viscera is one of the chief causes of shock. Rough handling and bruising of the tissues contributes largely to the postoperative abdominal complications so frequently seen. The central nervous system registers the shock resulting from such trauma. The incision must be long enough to permit thorough exposure of the operative field without employing undue traction. This is one of the cardinal principles in surgery. Would it not be a great contribution to good surgery if, in the early years of his professional career, every surgeon experienced at least one operation under local anesthesia?

Provision should be made for the maintenance of proper body heat during operation. This is especially important during operations about the liver.

Surgery of the female reproductive organs, for the removal of benign lesions, should be conservative.

An unreasonable amount of surgery should not be performed at one time even though the patient be a good surgical risk. Graded operative procedures are frequently life saving

measures Especially is this true of operations performed upon the colon in the presence of obstruction, whether due to malignancy or to other causes Obstruction should always be relieved early

It is unreasonable to expect the lower colon, especially if inflamed and indurated as it frequently is, to absorb sufficient liquids to maintain the proper fluid level of the tissues during the first few postoperative days A much more accurate and reliable method is to supply the tissues with the proper quantity of fluids by subcutaneous or intravenous administration

The different surgical procedures have been fairly well worked out and standardized Refinements in technique are constantly being added The range of operability is gradually being extended in many serious conditions Old methods are giving way to new But it is logical to assume that surgery of the future will progress largely in conjunction with, and as a result of, researches which will be made in physiology, bio-chemistry, and biophysics

C C HOKE

THE AMERICAN JOURNAL OF CANCER

THE appearance of the *American Journal of Cancer* in January, 1931, marks the beginning of an important addition to periodic medical literature This new journal, which is the official organ of the American Association for Cancer Research and of the American Society for the Control of Cancer, is a continuation of *The Journal for Cancer Research* and has a greatly enlarged editorial board with a correspondingly broader scope for the journal The first number contains 561 pages of which 243 are devoted to abstracts of the cancer literature, and both the original articles and the abstracts deal with all phases of the technical, administrative, and education problems that are offered by the malignant diseases The contemporary history of cancer, wherever it may be produced, will be found now in readily accessible and attractive form The editor, Dr Francis Carter Wood, is to be congratulated on this first number from the standpoint of its content, its make-up, and its promise

MASTER SURGEONS OF AMERICA

JOSEPH RANSOHOFF

JOSEPH RANSOHOFF was born on the twenty sixth of May, 1853, in Cincinnati, Ohio, where he graduated, in 1870, from the public high school. He immediately matriculated in medicine graduating in 1874 from the Medical College of Ohio, which, at this time, was one of the largest and best known schools in the country, numbering on its faculty many inspired and inspiring teachers. After securing his degree, he departed for Europe to devote himself to graduate study in Wurtzburg, Berlin, Vienna, Paris, and London. In these various centers, he came under the stimulating influence not only of the leaders in surgery but also of the pathologists, internists, and the more prominent teachers in allied clinical subjects. Koelliker, Virchow, Langenbeck, Billroth, Tillaux, Paget, Hebra, Rokitsky, Gerhardt, and Hutchinson seem to have made the deepest impress on his medical consciousness.

The European stay was prolonged for 3 years in order that the young enthusiast might attain membership in the Royal College of Surgeons of England. This degree he secured in April, 1877. He was contemplating his return home, when Sir James Paget recognizing his intellectual capacity and enthusiasm encouraged him to present himself at the examination for fellowship in the Royal College. Young Ransohoff accepted the counsel with the result that in June 1877, he won this very distinguished honor within the almost unprecedentedly short interval of 3 months after attaining his membership degree.

During the summer of 1877, Ransohoff returned to Cincinnati where he was almost immediately afforded the opportunities of demonstrating anatomy in the Medical College of Ohio, and of teaching surgery in the college dispensary. In 1879, after the death of the brilliant Langdon Longworth, he advanced to the position of professor of descriptive anatomy. About the same time he was appointed to the staff of the Good Samaritan Hospital, where he began to hold surgical clinics and to display, as a didactic clinical teacher, that unusual genius which won him a life long following of eager students. It was during these years that he became interested in surgery of the gall bladder, being among that group of American surgeons who were the first to execute operative attacks on this organ. In 1902, he accepted the chair of surgery in the Medical College of Ohio, later in 1909, he was given the same chair in the University of Cincinnati, when



JOSEPH RANSOHOFF
1853-1921

this institution was organized on the basis of a complete university. After the University of Cincinnati was given the control of the Cincinnati General Hospital, he found himself in a position calling for the talents of administrator, teacher, clinician, and stimulator of men. As we count years, Dr. Ransohoff was still a young man, almost a youth, when he found himself confronted with these large tasks.

How well he met the call can be told best in the words of his friend and biographer, Dr. Albert H. Freiberg: "It was now possible for Dr. Ransohoff to do things for the students of medicine not dreamed of when he began his career as teacher. The opportunity he now had for devoting a greater amount of time to teaching was seized with eagerness, which could not have been greater had it been the first chance of his life to show his ability and to establish his reputation. It were entirely fruitless to attempt the analysis of his success as teacher. A sufficient explanation is found in his enthusiasm and in that of his students."

A biography of Dr. Ransohoff in order to be complete must stress not only his discipline but also his intuitive grasp of surgical diagnosis, the sane conservatism which characterized his method of establishing the indications for surgical intervention, the soundness of his surgical judgment, and the deliberate sureness of his technique as contrasted with the ordinary concept of deadly brilliance.

Over a long stretch of years, he manifested a deep interest in the problems of so called organized medicine, and took seriously to heart the obligations of membership in the several organizations with which he was affiliated. Among these various societies he counted membership in the American Surgical Association, the Southern Surgical Association, and the Western Surgical Association.

His last presentation of a paper occurred in November, 1920, when in spite of the warnings of a rebellious heart, he delivered an address of particular charm on "Drake and Holmes," at the commemoration of the centennial of the Medical School. Following this address, his Alma Mater crowned his 40 years of tireless service with the degree of Doctor of Laws.

At the time of his death, he was director of the surgical service of the Jewish Hospital of Cincinnati and was largely responsible for the outstanding position which this hospital occupies among the institutions of its type.

From the time that he accepted his first teaching position up to within a short period before his death, he worked day in and day out, uninterruptedly, save for the usual vacation outings. During these years, Dr. Ransohoff published a series of one hundred and fifty papers, covering the entire field of general surgery. As an evidence of the evenness of method underlying his surgical life, it is interesting to note that these publications, beginning in 1879 continued up to within 4 months of his death, and that during all these 42 years there were only three that were barren. In addition to these numerous contributions to journal

literature, he contributed to Bryant and Buck's and also to Keen's *Systems of Surgery*

In August 1920, he suffered a threatening attack of angina pectoris. In spite of a compromised heart, he was able to enjoy 3 months of comparative comfort during the 7 months that intervened between his first and the final attack of angina which caused his death on the 10th of March, 1921.

This finishes the annals of the life of Joseph Ransohoff. But how much the tale smacks of the usual date, place, and name technique of the formal method of historical chronology! The present generation, fortunately, has been schooled, in almost all lands, to look for and to expect more than this. Strachey and Guedella in England, Maurois in France, Ludwig in Germany, Brandes in Denmark, Cushing Sandburg, Woodward and others in America have fired us with the taste of blood, and we claim as our right to know the man behind names, places, and dates. When we seek for the Joseph Ransohoff in the flesh, we find a lover of home and family, a man of charm and grace, a devotee to the silence of the forest and the warmth of the camp fire, a writer of tales, a teller of stories, *bon vivant*, trusted friend of colleagues and students, worshiper of the great among his colleagues of the past, and a delineator competent to cement his heroes skilfully into the pages of medical history with well turned phrases of a pleasing style. This is the Joseph Ransohoff whose passing is still a poignant memory to his friends at home and at large.

M. G. SEELIG

THE SURGEON'S LIBRARY

OLD MASTERPIECES IN SURGERY

ALFRED BROWN, M.D., F.A.C.S., OMAHA, NEBRASKA

THE SURGERY OF THEODORIC

AFTER him (Brunus) immediately came Theodorice, who, stealing all that Brunus had said, and adding certain fables of Hugo de Lucca, his master, published a book." In this sentence Guy de Chauliac dismisses Theodorice, but correct as he might be in the surgical ideas of his time, Guy shows himself somewhat wrong in his estimate of this author and may possibly have reversed the positions of Brunus and Theodorice for the latter was the son of Hugo de Lucca of whom Guy speaks and acted more or less as his amanuensis, writing after his death, and Hugo was a much older man than Brunus. It is necessary, therefore, in order to get an insight into Theodorice's surgery to study the life and work of his father.

Hugo Borgognoni or Hugo de Lucca lived during the twelfth and thirteenth centuries and died in the sixth decade of the thirteenth at an age of nearly one hundred years. He did not gain much prominence until the early part of the thirteenth century when he was called to Bologna in 1214. He then became an army surgeon for a time, served in the crusade, and was with the army in the siege of Damietta. In 1221 he returned to Bologna and helped to found the School which later attained such great fame. Hugo had five sons and of these three became physicians. They were taught by their father who was apparently much imbued with the ancient Greek ideas for he instructed them all according to the ancient Æsculapian family idea and handed his knowledge on to them under the seal of secrecy. Consequently, Hugo himself wrote no book and we must turn to his famous son, Theodorice, to learn his father's ideas. These he incorporates into his book, and, though in its general arrangement his book resembles that of Brunus, in some places the two being almost identical, there is much in Theodorice's work that is not even mentioned in Brunus's. To take one part as an example, Theodorice says "It has been told however, how that wonderful man master Hugo invented the method of using wine and stupes and ligatures alone to treat almost all wounds and healed, consolidated, and induced the most beautiful scars without the use of any ointments, rapidly and with skill, in the best way possible." There is no reason to believe that Theodorice is not telling the truth in this statement and if he is, Hugo is the founder of the school of wet dressings instead of Brunus to

whom Guy de Chauliac gives the credit. When Brunus wrote his surgery in 1252 he was 38 and Hugo was almost a hundred years of age and it is only reasonable to conclude that he had practiced his method and taught it to his son long before this.

Theodorice, Hugo's son, was born in Lucca and was six years of age when his father moved to Bologna. In addition to studying medicine he entered the order of the Dominican monks and spent the greater part of his life in close connection with the potentates of the church. He became the father confessor of Pope Innocent IV after he had been chaplain to the Catalonian, Andreas de Abbatas. Because of this connection he became first, the Bishop of Binoni and later Bishop of Cervia. In spite of these appointments he lived almost constantly in Bologna and had a large, lucrative practice. He died in 1298 at the age of 93 years.

Theodorice's surgery appeared in print first as part of the *Collectio Chirurgia Venetia* which was published in 1498. Later it was printed as part of the collection headed by the great surgery of Guy de Chauliac and the page reproduced here is from the edition of that collection which was printed by Gregorius de Gregorio at Venice in 1513.

The work is divided into four chapters or books. The first deals with wounds, ulcers, infections, etc., the second carries the subject further and describes these conditions as they occur in various parts of the body, the third is devoted to fistula, cancer, etc., and the fourth takes up the head, diseases of the eyes, paralysis, epilepsy, etc.

The introduction, which deals with the definition of surgery and its requirements, is almost identical in its ideas with the corresponding portion of Brunus's introduction. The language of Brunus is, however, a little more involved than that of Theodorice. Probably the most important advance that Theodorice made was in the treatment of fractures and dislocations. He was the first surgeon to wage war against, and discard the use of, the horrible machines which since the time of the early Greeks, and particularly since the time of Oribasius the Byzantine, had been used in the reduction of these deformities. Instead of these he advocates the use of broad bandages. He thus marks himself as one of the first surgeons to progress beyond medieval barbarism and employ humanitarianism in the treatment of his patients suffering from traumatic conditions.

REVIEWS OF NEW BOOKS

THE book by Flaskamp¹ contains a collection of all the known facts concerning possible damage resulting from the roentgen rays and other radio active substances and will undoubtedly find its way very soon into the library of every member of the legal and medical profession who has an active interest in the medicolegal aspects of X ray and radium damages. The book is a valuable contribution to science in that the literature of the world has been carefully studied and all the facts relating to damages from roentgen rays and other radio active substances have been gathered together in one work. The volume therefore constitutes a document of unusual worth.

JAMES T. CASE.

AFTER a brief historical introduction the author of *Die Schwangerschaftsdiagnose aus dem Harn*² defines clearly and concisely the principles underlying the method developed by Zondek and himself for the diagnosis of pregnancy from the urine. The chapters which follow explain in detail the technique and clinical results of the method pointing out sources of error and presenting corroborative evidence obtained from urine findings in pregnant animals. The final chapter is devoted to the application of their discovery of the anterior pituitary ovarian relationship to other facts of human physiology and pathology. In conclusion the author points out the far reaching possibilities of this method of investigation in solving questions of endocrine therapy.

A perusal of this monograph will leave little doubt in the mind of the reader that the procedure represents one of the outstanding contributions to medical science in recent times. The importance of this test extends beyond its clinical application to the early diagnosis of pregnancy since it throws light upon many hitherto unsolved problems of physiology and pathology of the endocrine system in general and of the sex glands in particular.

HAROLD C. MACK.

IN the compiling of the 1929 volume of *Collected Papers of the Mayo Clinic and the Mayo Foundation*³ a selection was made from 471 papers published by the Staff. Ninety are reprinted in full—23 are abridged 68 are abstracted and references are given to 290. As in the past preference was given to subjects of interest to the general practitioner, the diagnostician and the general surgeon, at least

so reads the foreword. However it would perhaps be more accurate to say that the subject matter embraces every recent advance in surgery. There is also much of interest for the internist and the general practitioner.

The subject matter is divided into systems. It would be vastly impossible to review all of the important matter presented here. The alimentary tract still claims the lion's share and deservedly so. For it was in the Mayo Clinic that so many of the important contributions to the surgery of the stomach, the duodenum, and the biliary passages were made. In this section Balfour contributes papers on dyspepsia on the problem of the recurrent peptic ulcer, and on the management of lesions of the posterior wall of the duodenum. Judd reports a case of total gastrectomy and discusses in another paper surgery of the biliary tract. Rankin contributes several papers to the surgery of the colon and rectum.

In the section on ductless glands the reader will find a number of interesting contributions such as "The Oxygen Treatment of Complications Incident to Goiter," "Surgical Treatment of Hyper Insulinism," "Management of Severe Goiter Cases," "Hyper Parathyroidism," etc.

In the section on blood and circulatory organs a paper of unusual interest for many reasons is that by W. J. Mayo. Its title is, "Surgical Aspects of Diseases of the Lymphoid Organs with Special Reference to the Spleen with a Statistical Report of the Results Following the Removal of the Diseased Spleen in 530 Cases." The clinical significance of such vast material analyzed by a master mind can hardly be overestimated.

To read this volume is to watch American surgery on its forward march.

GEORGE HALPERIN.

THE authors of *Physiologie Pathologique Chirurgicale*⁴ present certain pathological problems in surgical practice. The work is divided into chapters dealing with inflammation, trauma, repair of wounds, transplants, diseases of bones and joints, blood vessels and nerves. The authors present their own views based on their own clinical experience and experimental work. For this reason, references to the literature are largely omitted. Their attitude toward illustrations is rather interesting. They feel that illustrations particularly the use of many illustrations constitute one of the worst abuses of modern surgical literature. They believe that surgeons have become sufficiently intellectual not to require an appeal to the visual. Their preference is to appeal directly to the intellect of the reader.

The text discloses an intimate knowledge of the underlying fundamental sciences of physiology, his

¹ SONDERBEACHTENDE FÜR STRAHLENTHERAPIE. VOL. XII.—Ueber Roentgenstrahlen und Schäden durch Radioaktive Substanzen Ihre Symptome Ursachen Vermeidung und Behandlung. By Prof. Dr. Dr. Wilhelm Flaskamp. With a Foreword by Prof. Dr. med. et phil. Heiman Wintz. Berlin and Vienna: Urban & Schwarzenberg, 1930.

² DIE SCHWANGERSCHAFTSDIAGNOSTIK AUS DEM HARN (ASCHHEIM ZONDEK REAKTION) PRAKTISCHE UND WISSENSCHAFTLICHE FACHGESAMTHEIT AUS TAUSENDEN HORMONALEN HARNANALYSEN. By Dr. S. Aschheim Berlin 5. August 1930.

³ COLLECTED PAPERS OF THE MAYO CLINIC AND THE MAYO FOUNDATION. Edited by Mrs. Melish, Richard M. Hewitt, B.A. M.A. M.D. and Mildred A. Jellert, B.S. Vol. xvi, 1929. Philadelphia and London: W. B. Saunders Co., 1930.

⁴ PHYSIOLOGIE PATHOLOGIQUE CHIRURGICALE. INFLAMMATIONS. EFFETS DES TRAUMATISMES. RÉPARATION DES PLAIES. GREFFES MALADIES DES OS DES ARTICULATIONS. DES VAISSEAUX ET DES NERFS. By R. Lenchie and A. Polard. Paris: Masson et Cie, 1930.

tology, and pathology coupled with an analytical and philosophical attitude which make the reading of these short essays highly instructive and suggestive. This is surgical literature at its best. It clearly indicates the trend of modern surgical thought in the direction of physiological research.

GEORGE HALPERIN

AN unusual volume¹ has been written by Koblanck. The book embodies the results of many years of clinical experience and observation as well as the findings obtained by animal experimentation. It is the author's notion that the nose is intimately connected by way of its innervation with most of the important organs of the body. It is also his idea that because of this intimate connection, various diseases may be influenced by treatment of the nose. The pioneer work of Fliess in this connection is recognized and credit given to him and others. The number of diseases the author undertakes to influence partly by treatment directed toward the nose is legion, varying as it does from such disturbances of the female genital apparatus as amenorrhoea, dysmenorrhoea, sterility, etc., to other such disturbances as asthma, hay fever, neuroses of different types, epilepsy, migraine, and psychic ailments. Much of what the author takes for granted would not be acceptable in other quarters. A great deal of his conclusions are based upon shrewd clinical observation and in the future may be or may not be corroborated by evidence of a much more scientific nature. Such as it is the work has merit representing a large clinical experience in a field possessing unusual interest for all medical men.

The book is well documented with copious references to the literature and the author goes to great pains in giving detailed case reports of numerous patients in order to back up his conclusions.

S J P

THIS exhaustive treatise² deals entirely with the subject of hydronephrosis and its associated pathology. The latter naturally includes nearly all of the so called "surgical" diseases of the kidney. Beginning with the earliest recognition of hydronephrosis in 1672 the author enumerates in chronological order each valuable addition to the knowledge of the subject. This includes a clear and detailed reference to anatomical, physiological, pathological, and clinical contributions. A more complete resume cannot be found elsewhere. All experimental data on the subject of ureteral physiology and anatomy which have been published at home and abroad are cited.

In the clinical discussion the author has as a basis for his various conclusions a personal experience embracing several hundred instances of all types of ureteral and renal pelvis dilation. The atlas, which

contains 402 anatomical figures and reproduced pyelograms, is the most instructive of its kind recently published. The work is characterized by an unusual clarity and conciseness and, while considering hydro-nephrosis primarily, it really embraces nearly all the pathology of the kidney except nephritis. This book can be most enthusiastically recommended to all those who are interested in diseases which affect the upper urinary tract.

VINCENT J O CONOR

THE latest volume of the *Handbuch der Urologie*³ is an impressive symbol of German achievement in this specialty. On close inspection one is conscious of slight disappointment, especially in two particulars: the illustrations are neither as numerous nor as good as one expects from the German presses, and the references to the literature show few quotations later than 1923, and almost none later than 1925. Five years is a long time in modern medicine, and manuscripts that old already begin to show signs of senility.

The difficulty of classification is illustrated by the first chapter on the ureter. Previous chapters on general subjects have shorn this chapter down to ureteritis, stricture, ureterocele, and tumors. An excellent index helps to neutralize this difficulty, but it is to be hoped that the last volume to be issued will contain a general index referring to all the volumes.

Paschalis, in the chapter on the bladder, groups Fenwick ulcer, Hunner ulcer, and submucous cystitis under the general heading of ulcer simplex. It seems to the reviewer that this contributes to confusion rather than clarity. A section on the involvement of the bladder in hernias is interesting.

Joseph describes his method of chemical coagulation of bladder tumors with trichloroacetic acid for which he claims many advantages. In regard to radium implantation, he says that he feels that all of our present methods are so unsatisfactory for infiltrating carcinoma that the only real hope lies in the development of total cystectomy.

The scrotum, testes, epididymis, urethra, and penis are covered in rather orthodox fashion. One notes that it is advised never to use a suspensory in varicocele, and also that injections of iodine are admitted for obliterating congenital or communicating hernia.

Schwartzwald has produced a really encyclopaedic treatise on the seminal vesicles, a work which has been much needed. Blum and Rubritius contribute the chapter on the prostate. Latzo contributes a long chapter on "Gynecological Urology," which is evidently the work of a wise and experienced clinician. While there is little pathology, it bridges very usefully the gap which exists between urology and gynecology, and it is well worth careful reading.

D M D

¹ DIE NASE ALS REFLEXORGAN DES AUTONOMEN NERVENSYSTEMS. By Dr. Alfred Koblanck. With foreword by Prof. Dr. Friedrich Matthaei. Berlin and Vienna: Urban & Schwarzenberg, 1930.

² LES HYDRONEPHROSES. ANATOMIE ET PATHOGENIE. By Edmond Papin. Paris: G. Doin et Cie, 1930.

³ HANDBUCH DER UROLOGIE. Edited by A. v. Lichtenberg, F. Voelcker and H. Wildbolz. Vol. V. Spezielle Urologie III. Berlin: Julius Springer, 1928.

BOOKS RECEIVED

Books received are acknowledged in this department and such acknowledgment must be regarded as a sufficient return for the courtesy of the sender. Selections will be made for review in the interests of our readers and as space permits

CARE OF THE INFANT AND CHILD. A BOOK FOR MOTHERS AND NURSES. By Harry R. Litchfield M.D. and Leon H. Dembo M.D. Baltimore Waverly Press Inc. 1930

THE PRINCIPLES AND PRACTICE OF MEDICINE DESIGNED FOR THE USE OF PRACTITIONERS AND STUDENTS OF MEDICINE. Originally written by the late Sir William Osler, Bt M.D. F.R.S. 11th ed. rev. by T. McCrae M.D. New York and London D. Appleton and Company, 1930

UNIVERSIDAD DE CHILE BOLETIN ANUAL DE LA CLINICA GINECOLOGICA. Vol. 1 (1929) Santiago de Chile Imp. y Lito Leblanc 1930

TEXT BOOK FOR NURSES. ANATOMY, PHYSIOLOGY, SURGERY AND MEDICINE. By F. W. Hey Groves M.D., B.Sc. M.S. F.R.C.S. and the late J. M. Portescue Brickdale M.A., M.D. (Oxon.) M.R.C.P. (Lond.) The Medical Section Revised by J. A. Nixon C.M.G. M.D. (Cantab.) F.R.C.P. (Lond.) 4th ed. New York and London Oxford University Press 1930

BIOLOGIA Y PATOLOGIA DE LA MUJER. TRATADO DE OBSTETRICIA Y GINECOLOGIA publicado bajo la dirección de los Josef Halban y Ludwig Seitz. Traducido directamente del original alemán por Joaquín Núñez Grimaldo con la colaboración técnica del Dr. D. Arcadio Sánchez López Vols. v and vi Madrid Editorial Plus Ultra 1930

CLINICAL ALLERGY. ASTHMA AND HAY FEVER. MECHANISM AND TREATMENT. By Francis M. Hackemann M.D. New York The Macmillan Company 1931

ABDOMINO-PELVIC DIAGNOSIS IN WOMEN. By Arthur John Walscheid M.D. St. Louis The C. V. Mosby Company 1931

PRACTIQUE UROLOGIQUE CHIRURGICALE. By Ed. Michon and L. Michon Paris G. Doin et Cie 1931

LES TUMEURS CEREBRALES. LEUR MANIFESTATIONS. LEUR TRAITEMENT CHIRURGICAL. By Th. de Martel and J. Guillaume Paris G. Doin et Cie 1931

DEFORMITÄTEN UND KOSMETISCHE OPERATIONEN DER WEIBLICHEN BRUST. By Dr. Hermann Briesenberger Vienna Wilhelm Maudrich 1931

THE PATHOLOGY OF INTERNAL DISEASES. By William Boyd M.D. M.R.C.P. Fd. Dipl. Psych. F.R.C.S. Philadelphia Lea & Febiger 1931

TECHNIQUE AND RESULTS OF GRAFTING SKIN. By H. Kenrick Christie M.S. (N.Z.) F.R.C.S. (Eng.) New York Paul B. Hoeber Inc. 1931

PHYSICS OF RADIOLOGY etc. By J. L. Weatherwax M.A. With a Foreword by Henry K. Pancoast M.D. New York Paul B. Hoeber Inc. 1931

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SURGERY, GYNECOLOGY AND OBSTETRICS

AN INTERNATIONAL MAGAZINE, PUBLISHED MONTHLY

VOLUME LII

MAY, 1931

NUMBER 5

THE ANAL SPHINCTER AND THE PATHOGENESIS OF ANAL FISSURE AND FISTULA¹

ROBERT I. HILLER, M A, M D, MILWAUKEE, WISCONSIN
Associate to Surgical Staff Milwaukee General Hospital

THE stimulus for this work was furnished by the following interrogations of Prof A V Moschcowitz based on his clinical observations (1) Why do the usual descriptions of the external anal sphincter picture the muscle as attaching to the tip of the coccyx, when on palpation one feels it arising from the sides of the coccyx and extending forward to surround the anus as two lateral bands? (2) Why is the internal opening of the majority of anal fistulae constantly found just within the anocutaneous junction at a point corresponding to 5 or 7 on the clock, considering the posterior median line as 6 o'clock?

The latter observation is by no means wholly original. From the comprehensive clinical works of Esmarch and Quenu and Hartman, one learns that Ribes, in 1820, noted that the internal orifice of an anal fistula is usually just above the anocutaneous junction, exceptionally 10 to 12 millimeters above this level. It corresponds precisely with the zone of the semilunar valves, a zone easily moulable by virtue of the structure of the mucous membrane and its richness in lymphatic vessels. Velpeau confirmed the work of Ribes. "In 35 autopsies of fistula, he found the internal orifice in 4 cases at 38 millimeters, at 63 millimeters from the anus, in one case 76 millimeters, and in 300 (?) a few millimeters."²

Esmarch, in 1887, noted that in most cases the fistulae pass through the musculature of the sphincter, they seldom pass above the internal sphincter, and even less frequently are the fistulae very superficial with an opening distal to the musculature of the sphincter, hair-breadth in size, when they are known as subcutaneous fistulae or "fistulettes". In 1890, however, Reclus, quoted by Frey (22), found subcutaneo-submucous fistulae much more common than fistulae communicating with the ischiorectal fossa. The latter observation has been subsequently substantiated by most investigators. In 1887, Mr Swinford Edwards "pointed out that there seemed to be a definite relation between the internal and external orifices of a fistula. For fistulae having their external orifices situated behind a plane passing transversely through the center of the anus usually have their internal aperture in the middle line dorsally, while those with their external orifice in front of this plane generally terminate in an internal opening immediately opposite, thus forming a simple, straight, complete fistula." DaCosta quotes Tuttle to the effect that in *subcutaneous* fistula the *external* opening is usually within one inch of the anus, and the *internal* opening is usually external to Hilton's white line. The channel joining the openings is usually straight, but may encircle the anus. In *submuscular* fistula, the *internal* opening is

¹Translated literally from Quenu and Hartman p 162. The 300 probably should be 30.

²From the Senckenberg Institute for Pathology University of Frankfurt

usually between the sphincters. The *external* opening is an inch or more from the anus. Rotter and Davis also located the *internal* opening of submuscular fistulae between the two sphincters, whereas Quenu and Hartman found it above both sphincters. Among the works of modern proctologists, the following statements are found. Hirschman "The most common location of the internal opening of a fistula is at the posterior commissure of the anus between the sphincter muscles." Mummery "In the majority of cases they will be found to communicate at some point behind the anus, and from this communication a track will be found passing into the bowel posteriorly." Gant "In 95 per cent of fistulae, the opening is located in the posterior median line at the sphincter juncture, whether the sinus travels upward or downward or around the rectum. In other instances fistulae may penetrate the anal, middle, or upper rectum, or the sphincter muscle, but usually they enter the anal canal one half inch above the anus posteriorly in the median line." From this review, one gains the impression that the more recent writers recognize the posterior location of the internal opening of the majority of anal fistulae although no explanation is offered for the constancy of this phenomenon and a specific posterior point aside from the median line is not designated. Parenthetically, it is worthy of note that the *external* openings of fistulae are usually laterally located, except, as noted by Delbet and Melchior, in cases due to syphilis, rectum carcinoma, or osteomyelitis, although Frey has found exceptions to these observations.

A proper reply to the first query of Prof. A. V. Moschcowitz involves a complete study of the anal sphincters. One only realizes the necessity for such a study after a thorough review of the literature on the subject, when he finds a few fundamental and careful studies counterbalanced by a whole series of generalities. From an historical point of interest, Holl states that the first studies of any importance of the sphincteric musculature of the anus were made by Santorini. The following description from Quain's *Anatomy* (55), in 1834, gives one an idea of the earlier conceptions of the sphincteric musculature. "The sphincter

ani externus (coccygeo analis) is a flat elliptic muscle placed immediately beneath the skin surrounding the margin of the anus. It is attached posteriorly to the coccyx by a narrow fasciculus of tendinous fibers, and anteriorly becomes blended, about midway between the anus and the bulb, through the medium of a common fibrous point, with the transversi and acceleratores muscles, whilst the intervening part is disposed like orbicular muscles elsewhere, being composed of fleshy fibers curving round the intestine, and united by commissures before and behind it. One surface of the muscle is covered by the skin, the other rests on the internal sphincter, and on some cellular tissue which separates it from the levator ani. The sphincter ani internus is a flat muscular ring, surrounding the anal extremity of the rectum, it is about four or five lines in breadth and two thick. It obviously consists of the circular fibers of the intestine much more developed than elsewhere, and projecting lower down than the longitudinal fibers." In 1853, Treitz amplified the description by discovering the rectococcygeus muscle which bears his name and which consists of augmented longitudinal bowel muscle from the posterior surface of the rectum and anus extending to the coccyx and fixing the rectum. In 1858, Béraud described the same muscle under the name of "Muscle suspenseur du rectum." Luschka, 1864, described the external sphincter as consisting of "Hautmuskel" extending anteriorly and posteriorly to the anus and attaching to the fourth coccygeal vertebra. In 1874, Robin and Cadiat carefully studied the relationship of the longitudinal bowel fibers with relation to the sphincter muscles. Their description did not agree with that of Henle, who believed that the longitudinal fibers did not extend beyond the levator ani muscle. In 1881, C. Roux made a careful study of the anal musculature. Figure 14 represents a summary of his results. The most superficial fibers, "Hautmuskel" of Luschka, or "Sphincter superficial" of Cruveilhier, attach to the skin anterior and posterior to the anus. The second and larger group, "Sphincter profond" of Cruveilhier, arises from the dorsum of the tip of the coccyx, its fibers then cross before surrounding the anus.

to end in the centrum tendineum perinei, or to join musculus bulbocavernosus or musculus transversus perinei superficialis. Contrary to the conception of Henle, he found no fibers to the latter two muscles which did not cross in the midline anterior to the anus. He further described the deepest fibers as surrounding the rectum in unbroken rings. His description of the smooth muscle fibers of the longitudinal bowel coat and muscularis mucosæ with regard to their relations to the sphincter muscles greatly elaborates the work of Robin and Cadiat, he described the longitudinal muscle fibers as extending to the skin. Gegenbaur, 1890, demonstrated that fibers do pass to musculus bulbocavernosus or musculus sphincter vaginae of the same side almost constantly. He further described musculus sphincter externus as consisting of layers which embrace the lower bowel partly laterally, partly anteriorly, and partly posteriorly. One of the best studies of this subject was made by Holl, 1897. He divided the external sphincter into subcutaneous, superficial, and profundus layers. The subcutaneous layer is attached largely to the skin and begins with crossed fibers posterior to the anus and ends in the same manner anterior to the anus. The fibers may extend so far anterior as to form a musculus retractor scroti as commonly found in the cat. The superficial layer may arise from the skin but more commonly from the dorsal aspect of the coccyx through fibrous attachments. Some fibers cross posterior to the anus and then the whole layer extends around the anus anteriorly to the superficial fascia, centrum tendineum perinei, or to musculus bulbocavernosus of the same side. The profundus layer forms a ring around the rectum but the fibers are not unbroken as described by Roux but crossed anteriorly and posteriorly. The fibers which appear to enter the profundus layer from the musculus bulbocavernosus and musculus transversus perinei superficialis of the same side are found on closer examination actually to be fibers of the superficialis layer which pass into the musculus bulbocavernosus or insert on the tuberosity of the ischium and then appear to be a part of musculus transversus perinei. He finds analogies for the various layers in the

cat and rabbit. The profundus layer corresponds with the "sphincter internus" of Strauss-Durckheim found in carnivores, whereas the homologue of both the subcutaneous and superficialis layers consists of a muscle which arises from the dorsum of the root of the tail and in the rabbit surrounds the root of the tail, rectum, and penis in the fashion of a sling to insert into the skin of the dorsum of the penis and the corpus cavernosum penis. Fibers of the latter muscle arise from the corpus cavernosum penis and after surrounding the anus unite behind it. In addition, he describes a muscle, the musculus puborectalis or musculus sphincter recti, which encircles the anus deep to the musculus sphincter ani externus and superficial to the pubococcygeal division of the musculus levator ani. This musculus puborectalis arises from the os pubis and deep surface of the urogenital diaphragm and after encircling the anus inserts into the corresponding structures of the opposite side. Fibers from it enter the musculus transversus perinei superficialis of the opposite side, the musculus sphincter ani externus, and others after becoming tendinous accompany the longitudinal muscle fibers of the anterior surface of the bowel to the centrum tendineum perinei or the skin surrounding the anal outlet. This muscle is separated from the external anal sphincter by the inferior hæmorrhoidal vessels and the projections of obturator fascia which accompany them. Smooth muscle fibers do not extend as such to the skin, but their tendinous fibro-elastic extensions pass between and through the sphincter muscles to the skin.

The works of Robin and Cadiat, Roux, and Holl constitute the basis for most of the other descriptions found. Esmarch, Piersol, Cunningham, Waldeyer, Langer-Toldt, Spalteholz, and Braus still refer to the deep fibers of the musculus sphincter ani externus as ring-shaped, although Spalteholz does add that there are crossed fibers anteriorly and posteriorly. Hirschman refers to longitudinal or elliptical fibers and circular fibers. "The circular fibers are most superficial, entirely surrounding the anal canal." In Davis' *Applied Anatomy*, the muscle is described as follows: "The external sphincter surrounds

the lower part of the canal and stretches in a spindle shape from the tip of the coccyx to the central point or tendon of the perineum. Anteriorly, it blends with the fibers of the levator ani and other muscles of the perineum. It is a thick, powerful, voluntary muscle and extends outward from the white line of Hilton or mucocutaneous junction." The latter description finds many subscribers, although some of them add that the fibers cross posteriorly or anteriorly to the anus and send fibers to the musculus bulbocavernosus and musculus transversus perinei superficialis. Corning, Rauber-Kopsch, Testut and Jacob, Tandler, Landsman, Gant, and Mummery are among this group.

Ellenberger and Baum and Martin describe the anal muscles in tailed mammals as being largely suspended from the dorsum and sides of the vertebrae of the tail at its base. Waldeyer, Langer Toldt, Braus, Corning, Rauber Kopsch, Testut and Jacob, and Davis describe the external anal sphincter in man as arising from the tip of the coccyx. A study of the comparative anatomy of the coccyx shows it to be a rudiment of the tail. In fact Lartschneider was able to find all of the tail muscles represented in man. A more grotesque situation than anal musculature arising from the end of the vertebral column in tailed mammals could hardly be conceived. It seems unlikely, therefore, that in man an homologous point of attachment should be selected.

A short review of the experimental physiological and neurological work performed on the anal sphincter is also essential as a basis for this study.

Langley and Anderson (34-38), in a very extensive study on cats and rabbits, and v. Frankl-Hochwart and Froehlich on dogs, found two sets of vegetative nerves to the rectum and anus. The first, the hypogastric nerves, consists of fibers arising from the lumbar sympathetic, first to fifth lumbar, passing through the paravertebral sympathetic chain via the white rami to the inferior mesenteric ganglion, from which point they assume their identity, to pass into the pelvis to join the second set, nervi erigentes, or nervi pelvici of Langley and Anderson, to

form the pelvic plexus. The nervi erigentes arise from the first, third, and principally second sacral nerves. The external sphincter receives its innervation through peripheral nerves by way of the internal pudendal nerve.

The exact effects of each of these nerves has not been definitely concluded. The effects seem to vary in various animals. In the cat, Langley and Anderson, and in the dog, v. Frankl-Hochwart and Froehlich, produced contraction of the whole terminal end of the intestine, circular and longitudinal fibers, plus contraction of the sphincters by stimulation of the nervi erigentes. The degree of their constricting effect was shown by the fact that dilatation by stimulation of the nervi hypogastrici in dogs was only consistently produced, 9 out of 12 times, by v. Frankl-Hochwart and Froehlich, after the nervi erigentes had been completely removed. Stimulation of the nervi hypogastrici in cats and rabbits, however, produced variable effects in the hands of Langley and Anderson.

A review of this subject by Westphal discloses work establishing centers for anal control in the bowel wall itself (plexuses of Meissner and Auerbach), in neighboring plexus ganglia, in the lowest lumbar and upper sacral segments of the spinal cord, in the second and third lumbar segments of the spinal cord, in the region of the optic thalamus, and in the cerebrum in the region of the sulcus cruciatus. Through the spinal and cranial centers, psychic and peripheral nerve stimulating effects manifest their influence on continence.

Stimulation of the nervus hæmorrhoidalis medius of the dog, corresponding to the inferior hæmorrhoidal nerve of man, causes energetic closure of the anus. Cutting of this nerve causes wide anal relaxation at first, followed by a lessening of the degree of this relaxation. Defæcation becomes difficult because the sensory nerve reflexes which travel through the internal pudendal nerve are obliterated (Westphal). If the nervi hypogastrici and nervi erigentes are both cut, paralysis of the sphincters but also a continued urgency to stool appears, often not until 2 or 3 days, abating only after weeks or after the internal pudendal nerves are cut (Lewandowsky and Schulz, and Deunig). When all of the

nerves are cut, voluntary control disappears because of the loss of the feeling of fullness carried by the internal pudendal nerves necessary to stimulate defecation. Goltz and Ewald studied the external anal sphincter after complete destruction of the lumbar and sacral spinal cord in the dog. The internal sphincter regained its tonus, whereas the external sphincter remained paralyzed, although it gave no reactions of degeneration and remained responsive to electrical stimulation in animals that outlived the operation for a considerable time after all the other skeletal muscles have ceased to react. According to Westphal, Arlong and Chantre demonstrated that 11 months after the destruction of its supplying sacral nerves, the external sphincter muscle did not change histologically but manifested twitching reactions somewhat similar to smooth muscle. Von Frankl-Hochwart and Froehlich found that after an animal had been poisoned by curare, the external anal sphincter continued to react to stimulation long after the other striated muscles had become irresponsive. Recently Beck, by electromyographic methods, concluded that the sphincter musculature, without specific differentiation of muscles, possesses tonus which returns within a definite period after dilatation. Because of its immunity to curare and because of its reaction as a whole on electrical stimulation, the external anal sphincter, too, has been conceived to possess nerve centers similar to those of the myenteric plexus of Auerhach.

The work of Matti throws a new light on the inter-relationship of the internal and external anal sphincters and clarifies with simplicity their actions during defecation. He demonstrated on dogs that if the external anal sphincter be cut bilaterally the internal sphincter keeps the anus closed unless the finger is introduced into the anus when the muscle relaxes after about 15 or 20 seconds and fails to regain its tonus. The internal sphincter then responds peristaltically as a part of the rectum and about one-half centimeter of mucous membrane becomes visible. When, however, the external sphincter is repaired, the internal sphincter assists in closing the anus through the mechanical, not reflex, stimulation of its intramuscular plexus by the per-

sistent tonus of the external sphincter. The visible mucous membrane disappears from view and the grip is maintained on the palpating finger indefinitely. The return of anal tonus about one month after the removal of all extrinsic anal innervation is attributed by Matti to the fibrosis and shrinking which accompanies the atrophy of the external sphincter fibers. The internal sphincter becomes grasped in the shrunken external sphincter and as a result of mechanical stimulation regains its tonus.

METHODS OF INVESTIGATION

The greatest difficulties and inaccuracies in tracing muscle fibers have probably arisen from the use of fixed anatomical material. In this study, fresh anatomical material was used for all gross work. Twelve adults and one child of 8 years were used for the study of the muscles and fascia. The coccyx, perineum, and pelvic organs were removed *en masse* and then the vessels, fascia, and muscle fibers were prepared. The arteries in 5 of these specimens were injected with a gelatine-dye solution before removal of the specimen from the body. When doubt existed as to whether a muscle were smooth or striated, a small piece was removed and examined. Several newborn infants were also injected and dissected. In the latter instances the entire pelvis was frequently removed instead of the perineum and pelvic organs. Microscopic studies of the musculature stained with hematoxylin-eosin, and by Van Gieson and elastic tissue stains were made in specimens from the infants and from a female aged 4 years. Microscopic nerve study in the infants was unsatisfactory but good preparations were obtained from the adults by the Bielschowsky technique on teased tissue and frozen sections.

All striated muscle fibers in the anal triangle superficial to the level of the urogenital diaphragm and the level at which the inferior hemorrhoidal vessels pierce the striated muscle sheath of the anus as they extend from the ischiorectal fossa, were considered as the external sphincter ani muscle. Likewise, the muscular fibers passing from and to the ano-coccygeal raphe superficial to the posterior

space connecting the ischioanal fossæ were considered as part of the musculus sphincter ani externus. In several of the specimens, the demarcation between this muscle and levator ani muscle was very difficult.

RESULTS

A Muscles The results of the study of the sphincter musculature are shown in Figures 1 to 13 inclusive. They may be summarized as follows:

1 The superficial fibers of the musculus sphincter ani externus (a) may extend anteriorly and posteriorly on each side of the anus as shown in Specimen 1 in which the fibers cross anteriorly to enter the musculus sphincter vaginæ, in Specimen 2, in which crossed and uncrossed fibers pass anteriorly to musculus sphincter vaginæ, perineal scar, in Specimens 3, 4, and 5, in Specimen 12, perineal scar (b) may simply surround the anus posteriorly, arising and ending in the region of the centrum tendineum perinei, as shown in Specimen 13, in Specimen 9, in which crossed and uncrossed fibers pass anteriorly to centrum tendineum perinei and musculus sphincter vaginæ (c) may consist of both of the foregoing types as in Specimen 8 in which uncrossed fibers pass anteriorly to musculus transversus perinei superficialis, in Specimen 4 (d) or, the superficial fibers may encircle the anus anteriorly plus fibers which extend anteriorly and posteriorly, as in Specimen 7, in which crossed and uncrossed fibers pass anteriorly to musculus sphincter vaginæ, perineal scar, or as in Specimen 10. The most superficial fibers of this layer attach to the skin anteriorly and posteriorly to the anus.

2 The deeper layer of the musculus sphincter ani externus may consist (a) largely of fibers which encircle the anus posteriorly, as in Specimen 1 in which crossed and uncrossed fibers pass anteriorly to the musculus sphincter vaginæ and the musculus transversus perinei superficialis. One small group associated with the internal sphincter posteriorly encircles the anus anteriorly, in Specimen 2, perineal scar, in Specimen 4, in which are fibers to the centrum tendineum perinei plus crossed and uncrossed fibers anteriorly to the musculus bulbocavernosus and musculus transversus

perinei superficialis, in Specimen 10, in which crossed and uncrossed fibers pass anteriorly to the musculus sphincter vaginæ and the musculus transversus perinei superficialis, posteriorly, marked communications with longitudinal bowel coat and fibers passing laterally to the musculus levator ani, in Specimen 11, in which crossed and uncrossed fibers pass anteriorly to the musculus bulbocavernosus and the musculus transversus perinei superficialis. Fibers pass posteriorly to the musculus levator ani, in Specimen 12 crossed and uncrossed fibers pass anteriorly to the musculus sphincter vaginæ and the musculus transversus perinei superficialis. Posteriorly, fibers pass to the musculus levator ani, in Specimen 13, in which are fibers to the centrum tendineum perinei plus crossed and uncrossed fibers anteriorly to the musculus transversus perinei superficialis (b) of fibers which encircle the anus anteriorly, as in Specimens 5 and 6, in which a very few fibers pass into the centrum tendineum perinei and some cross into the musculus transversus perinei superficialis of the opposite side (c) of fibers which encircle the anus posteriorly plus fibers which encircle the anus anteriorly, as in Specimen 3, in which there are a few anterior encircling fibers, posterior encircling fibers which extend to the centrum tendineum perinei or cross anteriorly to enter the musculus levator ani, musculus transversus perinei superficialis or the musculus bulbocavernosus, and uncrossed to the musculus bulbocavernosus (d) of fibers which encircle the anus posteriorly plus fibers which extend anteriorly and posteriorly, as in Specimen 8, in which there is distortion of fibers in the perineum due to scar (e) of fibers which encircle the anus anteriorly plus a greater number of anteroposterior fibers, as in Specimen 9 (f) of fibers which neither encircle the anus anteriorly or posteriorly but cross anteriorly or posteriorly to produce the condition shown in Specimen 7, perineal scar. The close inter relationship between the superficial and deep fibers of the external anal sphincter are shown in Specimen 10.

3 The internal sphincter ani muscle varied in thickness from 0.5 millimeter to 3 millimeters, and in width from 3 millimeters to 2

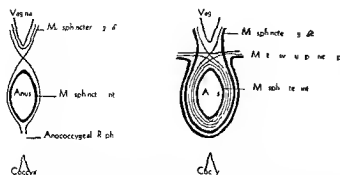


Fig 1 Specimen 1 Nulliparous female aged 19 years Death from pulmonary tuberculosis Left figure the very superficial fibers of the sphincter ani externus, only about two or three in number, pass from the anococcygeal raphe around the anus to the musculus sphincter vaginae of the opposite side Right figure the deeper fibers of the sphincter ani externus constitute the main group and consist of fibers encircling the anus posteriorly from and to the musculus transversus perinei superficialis and the musculus sphincter vaginae Some fibers cross anterior to the anus A few fibers of the deep layer encircle the anus anteriorly and are associated with the longitudinal bowel fibers posteriorly The anococcygeal raphe is poorly developed consisting only of a fibrous band and a few superficial muscle fibers A few muscle fibers extend from its deep surface to levator ani of each side A posterior communicating space between the ischiorectal fossae is present The sphincter ani internus is 2 millimeters thick and 3 millimeters wide The musculus transversus perinei superficialis is well developed and consists of fibers extending directly across the midline plus fibers received from the musculus sphincter ani externus The musculus sphincter vaginae also had independent fibers in addition to those received from the external anal sphincter Terminations of longitudinal bowel fibers are numerous at the anterior and posterior commissures but form only a thin layer laterally

centimeters The muscle is formed by a heaping up of the terminal circular fibers of the bowel It can usually be palpated as a distinct band, although in Specimen 4 the fibers did not form a complete circle Of the specimens examined, the muscle seemed more prominent in the females than in the males

4 The longitudinal muscle fibers of the bowel terminate as fibro-elastic extensions which traverse external and internal sphincter ani muscles as described by Robin and Cadiat and Holl, and not as smooth muscle fibers as described by Roux, Cunningham, Piersol, Gant, Waldeyer, and others The fibro-elastic terminations which traverse the internal sphincter muscle to join the terminations of the muscularis mucosae insert partly into the uncornified stratified squamous epithelium between the mucous membrane area and the cornified skin region Part of these fibers pass around the superficial surface of the internal

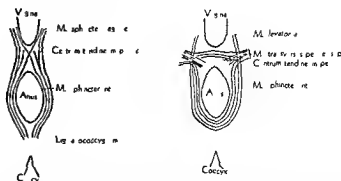


Fig 2 Specimen 2 Female aged 67 years Death from carcinoma of the pancreas Left figure superficial fibers of the sphincter ani externus Right figure deep fibers of the musculus sphincter ani externus with a few fibers of the levator ani muscle Anterior to the anus is a cicatrix probably the result of an intrapartum laceration The anococcygeal raphe is well developed and a posterior communicating space between the ischiorectal fossae is present The musculus transversus perinei superficialis is well developed and some of its fibers crossing the midline appear to have escaped injury The terminations of the longitudinal bowel fibers attaching to the skin are very numerous

sphincter ani to intermingle with the fibro-elastic terminations of the longitudinal layer which pass between the two anal sphincters on their way to the cornified skin at the margin of the anus In this manner the internal sphincter ani is almost completely covered on its superficial, medial, and lateral surfaces by fibro-elastic terminations, most numerous in the anterior and posterior commissures and least numerous in the posterolateral quadrants (see Fig 3, A) In fact sections through the posterolateral quadrants disclose a marked deficiency of these fibers especially where the inferior hæmorrhoidal vessels pass to the sub-mucous layer Anteriorly and posteriorly the fibro-elastic terminations pass to the centrum tendineum perinei and ligamentum anococcygeum respectively Smooth muscle fibers as such were observed passing into the levator ani muscle, the superficial transverse perineal muscle, the external sphincter ani, and the rectococcygeus muscle

5 The rectococcygeus muscle was present in all specimens examined No attempt was made to determine the presence of striated muscle fibers in this muscle as maintained by Roux

6 The tail muscles as described by Lart-schneider, aside from the levator ani muscle, were not studied These muscles are the coccygeus, the levator ani, the sacrococcygeus anterior, the sacrococcygeus posterior,

and the group of smooth muscle fibers lying upon the rectococcygeus muscle of Treitz corresponding to the "Afterschweifband" in tailed mammals

7 The anococcygeal raphe was studied with relation to the sphincter ani externus muscle. The fibrous extensions of this muscle were found to extend over the dorsum to the sides of the coccyx. Between the dorsum of the coccyx and the ligamentous extensions of the external anal sphincter, the bursa described by Luschka was constantly found. The termination of the middle sacral artery was found to pass dorsalward through a small hiatus distal to the tip of the coccyx. No attachments of the sphincter ani to the tip of the coccyx were found. In Specimens 1, 8, 9, and 12 the anococcygeal raphe was poorly developed, and in Specimen 8, it was almost insignificant.

B Fascia The ischiorectal fossa was found to be lined with the fascia covering the superficial surfaces of obturator internus and levator ani muscles. This fascia is continuous with the fascia covering the gluteal muscles laterally, Colles's fascia or the superficial fascia of the superficial perineal space, and the fascia covering the deep surface of the urogenital triangle, deep to which is found the pubic extension of the ischiorectal fossa described by Waldeyer. On the medial surface of the ischiorectal fossa the fascia may extend as far superficial as the outer margin of the external sphincter ani. The inferior hemorrhoidal vessels and nerves pass through the ischiorectal fossa accompanied by an exceedingly thin fascial sheath which extends from the point where they pierce the obturator fascia covering Alcock's canal to the points where they pierce the fascial covering of the medial surface of the ischiorectal fossa. Between the ischiorectal fossae posteriorly is a fat filled space by means of which the fossae can communicate by rupturing an almost insignificantly thin fascial layer. The same communicating possibilities existed anteriorly in Specimens 5 and 6. In Specimen 9 the posterior communication lay superficial to the anococcygeal raphe, whereas in all of the other specimens it was found deep to that structure.

C Arteries In general, the distribution of the hemorrhoidal arteries in the specimens conformed with the description of Cunningham, namely "The inferior hemorrhoidal artery is distributed chiefly on the posterior, and the middle hemorrhoidal chiefly on the anterior aspect of the lower part of the bowel." This is true for the anal canal excepting the anal sphincter region where the anterior two thirds of the sphincter muscles and anal outlet were found to be supplied by the perineal artery, anastomosing above with the middle hemorrhoidal artery, which in turn anastomosed above with the superior hemorrhoidal artery, whereas, the posterior third of the sphincter muscles and anal outlet were found to be supplied by the inferior hemorrhoidal artery, anastomosing above with the superior hemorrhoidal artery. The termination of the middle sacral artery, the important tail artery of tailed mammals, was found in the anococcygeal raphe, therefore, it plays no direct part in the blood supply of the sphincters and anal canal. The perineal artery was found to leave the internal pudendal artery and pass medialward in the superficial perineal space, as described in Davis' *Applied Anatomy*. In this manner the perineal artery reached the sphincter muscles and anal region passing into a fascial fold pictured by Rauber, essentially isolated from the ischiorectal fossa.

The detailed distribution of the inferior hemorrhoidal artery and the perineal artery was found to be as follows (see Figure 15).

1 The artery of the perineum divided into two main branches in the superficial perineal space. (a) The anterior of these two branches passed medially at a very slight angle and divided into (1) four or five small branches to the longitudinal bowel coat, (2) one branch which passed through the longitudinal bowel coat to appear on the mucous surface superficial to the internal sphincter. (b) The posterior of these branches passed medially at a slightly greater posterior angle and divided into (1) a branch which passed posteriorly in the deepest layer of the external sphincter to anastomose with a branch from the inferior hemorrhoidal artery, (2) several fine branches to the superficial layers of the external sphincter in its anterior two thirds, (3) a branch

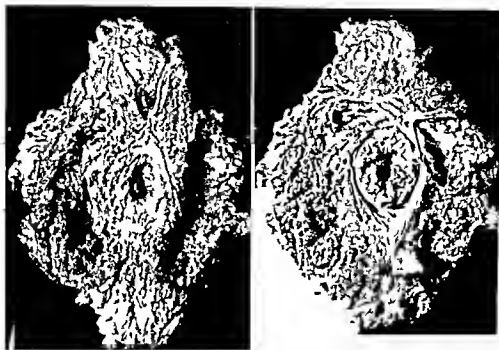


Fig 3 A

Fig 3. Specimen 3. Male aged 50 years. Death from peri arteritis nodosa. Left figure: superficial fibers of the sphincter ani externus. Right figure: deep fibers of the sphincter ani externus. A very small number of fibers encircle the anus anteriorly and extend posteriorly to the anococcygeal raphe. Most of the fibers encircle the anus posteriorly and extend to the centrum tendineum perinei, to the levator ani, the transversus perinei superficialis, or the bulbocavernosus of the opposite side, or uncrossed to the bulbocavernosus. The anococcygeal raphe is well developed and a posterior communicating space between the ischioanal fossae is present. The musculus transversus perinei superficialis is poorly developed. Terminations of longitudinal bowel fibers cover the superficial surface of the

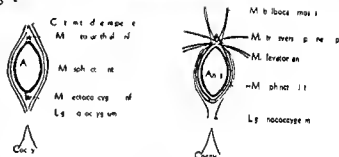


Fig 3

sphincter ani externus. They are especially abundant at the anterior and posterior commissures.

with three sub-branches which passed between the two superficial layers of the external sphincter (see Fig 15 A) to send one branch to the submucous region, one to anastomose with a deeper branch of this posterior division, and one to the most superficial layer of the external anal sphincter.

2 The inferior haemorrhoidal artery is divided into three main branches: (a) the deepest branch coursed beneath the obturator and levator ani fascia and divided into five branches to musculus levator ani, (b) the second branch extended directly medially and divided into four branches: (1) one extended anteriorly on the deepest layer of the external anal sphincter to anastomose with a branch of the posterior division of the artery of the perineum, (2) one extended posteriorly on the same muscle layer, (3) one extended to the most

superficial layer of the external sphincter, and (4) one passed between the two superficial layers of the external anal sphincter to pierce the longitudinal bowel coat and help supply the most superficial layer of the external anal sphincter, (c) the posterior and largest branch divided into: (1) one twig to the deepest layer of the external sphincter, (2) one which passed between the superficial and deep fibers of the external sphincter and external to the longitudinal bowel coat to appear on the submucous layer, superficial to the internal sphincter, (3) one branch to the superficial layer of the external sphincter, (4) two branches to the most superficial layer of the external sphincter, and (5) one branch which passed superficial to both external and internal sphincter muscles to appear in the submucous layer. Branches 2 and 5 were located

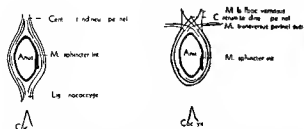


Fig 4. Specimen 4. Male aged 20 years. Death from pancreatitis. Left figure: superficial fibers of the sphincter ani externus. Some arise from the skin anterior to the anus and insert into the skin posterior to the anus. The greatest number of them however pass from the centrum tendineum perinei to the ligamentum anococcygeum. Right figure: the deeper fibers of the sphincter ani externus arise from the musculus transversus perinei superficialis, the musculus bulbocavernosus and the centrum tendineum perinei. They pass around the anus posteriorly to insert in the centrum tendineum perinei, the musculus transversus perinei superficialis and the musculus bulbocavernosus of the same or opposite side. A mass of fibrous tissue attaches this layer to the coccyx. The anococcygeal raphe is well developed and a posterior communicating space connects the ischioanal fossa. The musculus transversus perinei superficialis is fairly well developed. The sphincter ani internus does not form a closed circle but overlaps. Terminations of longitudinal bowel fibers pass anteriorly into the musculus transversus perinei superficialis.

at approximately 5 o'clock on the posterior anal commissure. On the right side (left side of Figure 15) essentially the same arterial distribution prevailed except that another twig from the posterior division passed between the superficial layers of the external sphincter to the submucosa between the two branches 2 and 5 latterly described. Branch 2 on the right side was separated from the corresponding branch on the left side by the firm fibro elastic band at the posterior commissure.

Branches b and c passed through the fat of the ischioanal fossa as previously described under "B Fascia." In this fossa many twigs, too numerous to designate with constancy, branched off to supply the fat and overlying skin. Rarely, cutaneous twigs from the artery of the perineum were noted.

D Veins. In general the veins follow the same courses as the arteries. In the submucous layer of the anus, however, in the region of the columns of Morgagni the inferior hæmorrhoidal veins form ampullary enlargements by their anastomoses with the superior and middle hæmorrhoidal veins. These anastomoses form the submucous or internal

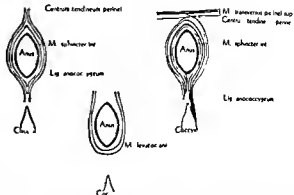


Fig 5. Specimen 5. Male aged 66. Death due to pneumonia. Left figure: the superficial fibers of the sphincter ani externus arise from the centrum tendineum perinei and insert into the anococcygeal raphe. Right figure: the deeper fibers of the sphincter ani externus encircle the anus anteriorly to pass into the anococcygeal raphe. A very few fibers pass into the centrum tendineum perinei and some cross into the musculus transversus perinei superficialis of the opposite side. The anococcygeal raphe is well developed and the ischioanal fossa are connected both anteriorly and posteriorly by communicating spaces. The musculus transversus perinei superficialis fibers cross directly. Center figure: fibers of the levator ani, lying deep to those of the sphincter ani externus, encircle the anus posteriorly in particular abundance.

hæmorrhoidal plexus. The veins are more numerous in the submucous layer than the corresponding arteries.

E Nerves. The inferior hæmorrhoidal nerves accompany the arteries through the ischioanal fossa in the fine fascial sheaths already described. Similarly the perineal nerve accompanies the artery in the superficial perineal space. Thus in reality, the external sphincter receives innervation in each of its four quadrants. The nerves enter the external sphincter at approximately a right angle to the direction of its fibers. The nerve fibers then spread out over the muscle fibers forming a plexus with numerous anastomoses called "intermuscular plexuses" by Stoehr. Unlike the ordinary nerves to skeletal muscle as described by Bardeleben (cited by Poirer and Charpy), the nerve fibers parallel the muscle fibers for but very short distances. Distances greater than two low power microscopic fields were only rarely found. Conforming with the findings of Boeke, for ordinary striated muscle, both motor and sympathetic end plates were found in the external sphincter ani. A definite plexus corresponding to the myenteric plexus of Auerbach was not identified.

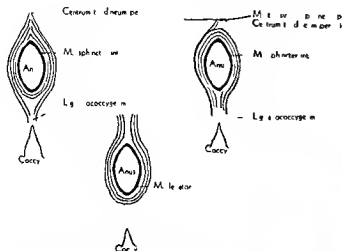


Fig 6 Specimen 6 Male aged 45 years Death due to carcinoma of the lung with metastases to the cranium and liver Left figure the superficial fibers of the sphincter ani externus are of two varieties The central small group encircles the anus posteriorly and converges anteriorly just as does the outer group which arises from the anococcygeal raphe Right figure the deep layer of the sphincter ani externus also consists of two types of fibers The largest group passes from and to the anococcygeal raphe around the anus anteriorly A few fibers pass to the centrum tendineum perinei and to the musculus transversus perinei superficialis Central figure the fibers of the levator ani surrounding the anus posteriorly are particularly well marked They tend to converge anterior to the anus where some of the fibers are attached to the centrum tendineum perinei The anococcygeal raphe is well developed and the



Fig 6 A

ischioanal fossae are connected by posterior and anterior communicating spaces The musculus transversus perinei superficialis is very poorly developed

tified although several small knobs and snarls of fibers exclusive of the nerve endings were of suggestive character The uncertainty of the whole subject of striated muscle innervation makes a definite statement impossible at this time The subject is thoroughly reviewed by Stoehr and Mueller Nerve fibers were noted entering the levator ani muscle from the perineal branch of the internal pudendal nerve contrary to Braus' observations and in accord with the observations of Quain and others

F Lymphatics No special study of the lymphatics was made However, in a few of the cases examined, death was due to tuberculosis and chains of enlarged glands in the pelvis were noted to conform with the classical descriptions of Gerota, and Poirer and Cuneo, quoted by Lynch and Felsen, Gant, and Davis

DEDUCTIONS

Why is the internal opening of the majority of anal fistulae constantly within the anocutaneous junction at points corresponding to 5 and 7 on the clock, considering the posterior median line as 6 o'clock?

Excluding the epithelized fistulae due to congenital anomalies resulting from the indentation of the proctodeum (Bartholdy), pulsion diverticula arising through propulsion of a crypt of Morgagni by a foreign body (Meissel) associated with ulceration and traversing both sphincter muscles (Chuan), or from cystic degeneration of a Sinus Hermann (Tavel) or a cyst of Physick, although the cysts of Physick have been described as diverticula resulting from the rupture of a submucous hemorrhage into the bowel, and excluding also fistula due to stricture of the rectum (Salmon), fissure (Mummery), osteomyelitis of the coccyx, carcinoma, syphilis, gonorrhoea, typhoid, bacillary or amoebic dysentery, foreign bodies, injection of hemorrhoids or other operative or non-operative rectal injuries, the common or remaining type of fistula *in ano* has been conceived by Hippocrates, Arderne, Bryant, Cruveilhier, Aschoff, Davis, Esmarch, Gant, Hirschman, Kaufman, Mummery, Quenu and Hartman, Rotter, and others as following periproctitis or abscess In spite of the settlement of the controversy regarding

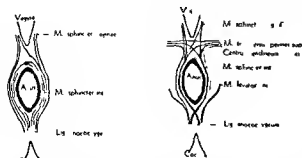


Fig 7 Specimen 7 Female aged 38 years. Death from meningitis following a mastoid operation. Left figure the superficial fibers of the sphincter ani externus arise from the anococcygeal raphe and either encircle the anus anteriorly or extend anteriorly into the musculus sphincter vaginae of the same or opposite side. The area between the vagina and anus is occupied largely by scar tissue. Right figure the deeper fibers arise from the deep surface of the anococcygeal raphe and extend either around to the musculus transversus perinei superficialis on the same or opposite side or to the musculus sphincter vaginae on the same side. These fibers cross posteriorly on the deep surface of the anococcygeal raphe. Fibers also pass from the anococcygeal raphe to the levator ani on the same side. Fibers of the musculus levator ani not shown in the sketch encircle the anus posteriorly. The anococcygeal raphe is well developed and the ischioanal fossa are connected posteriorly by a communicating space. The sphincter ani internus is 3 millimeters thick and unusually well pronounced. The musculus transversus perinei superficialis is fairly well developed and possesses a few fibers which cross the midline directly, but most of its fibers are interrupted in the region of the centrum tendineum perinei by scar tissue. Many terminations of the longitudinal bowel coat pass into the musculus transversus perinei superficialis anteriorly. Terminations of longitudinal bowel fibers are prominent around the whole circumference of the anal outlet except in the posterolateral quadrants.

the part played by tuberculosis in the etiology of anal fistula, stimulated by Melchior and concluded by Gabriel, one is surprised to note that Sigmund in the new "Henke and Lubarsch" considers the work of Melchior as conclusive, although Frey in 1913 showed that Melchior's conclusions of 1910 were based on the findings of tuberculosis in 5 out of 10 suspected cases. Gabriel's figure of 20 per cent based on the careful examination histologically and by animal inoculation of 75 successive cases, is a bit higher than generally conceded clinically by proctologists, but is probably more accurate.

Given, then, a peri anal abscess the pathogenesis of which will be considered later, why is the internal opening constantly located as previously described? A short study of Figure 15 discloses that the points of entrance into the submucosal space of vessels from the

ischioanal fossa and anal region corresponds with 5 and 7 on the clock. The pus has only to follow the thin vascular sheaths and a single internal opening on each side and numerous external openings will likely result. It would seem unusual for pus to enter the external perineal space from the ischioanal region, and consequently its entrance into the anal canal in its anterior two thirds is prevented. Exceptionally, however, superficial communications do exist between the branches of inferior hemorrhoidal artery and the artery of the perineum and then the unusual anterior openings are explained. The previously described phenomena observed by Edwards and Tuttle with regard to the openings of fistulae are also explained by these anatomical conditions. The horseshoe fistula and the rarity of anterior communications is also clarified by a comparison of the frequency of the anterior and posterior spaces connecting the ischioanal fossa.

How does the peri anal abscess arise?

It is not difficult to conceive of the method of origin of an abscess in one of the peri anal sebaceous glands or glands of Gay, but an abscess in order to bear an etiological relation to fistulae will most likely be of enterogenous origin. How the infecting organisms get into the peri anal tissues, has been a subject of much dispute. Bryant, in 1861, disagreed with the popular conception that an abscess is always preceded by an ulcer. If this were true, every case of abscess would be associated with a fistula. However, of 236 cases of abscess fistula, or both, 43 cases began and ended as abscess without developing a fistula. Foreign bodies have been a popular etiological factor in abscess formation. Esmarch ascribed the etiology of some cases to suppuration of a hemorrhoid. In addition to the predisposing causes of rowing and riding (Hippocrates), local trauma and exposure to cold, Quénu and Hartman believed that lymphangitis of rectal origin was the most important factor in the development of abscess in spite of the absence of inguinal adenopathy. The adenopathy is prevented by thrombosis in the lymphatics preventing further progress of the infection. If the presence of lymph glands in the ischioanal rectal fossa as shown in an illustration by

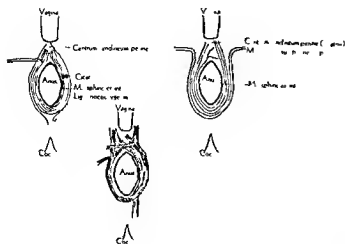


Fig 8 Specimen 8 Female aged 72 years Death from bronchopneumonia Left figure superficial fibers of the sphincter ani externus Two fibers arising from the centrum tendineum perinei extend posteriorly toward the ano coccygeal raphe The remaining fibers of this layer arise abruptly on the right side in the anterior quadrant and either pass directly forward to the centrum tendineum perinei or encircle the anus posteriorly to insert into the centrum tendineum perinei and the musculus transversus perinei superficialis of the left side This layer is attached to the deepest layer on the right side by a short fibrous band Right figure the middle layer of fibers of the sphincter ani externus, 1 centimeter wide and 2 millimeters thick, encircles the anus posteriorly and inserts uncrossed into the musculus transversus perinei superficialis and an area of scar tissue anterior to the anus Some fibers from the left side pass across the scarred area to be attached by fibrous tissue to the fibers of the right side They are not continuous Center figure the deepest fibers of the sphincter ani externus arise on the right side from the area of scar tissue anterior to the anus and from the area posterolateral to the vagina They encircle the anus posteriorly and insert into the deep surface of the left musculus transversus perinei superficialis and the left posterolateral vagina area Some fibers return to the right posterolateral vagina area and, passing deep to the fibers above described, proceed posteriorly toward the coccyx on the right side Fibers from the middle layer lying superficial to the deep fibers above described, pass from the left side to the right posterolateral vagina area The sphincter ani externus in



Fig 8 A

this specimen has only an insignificant attachment to the coccyx and the ischioanal fossae communicate through a large posterior space The sphincter ani internus is 1 millimeter thick and 3 millimeters wide It lies deep in the anal pit and is not a pronounced ring The musculus transversus perinei superficialis is fairly well represented

(Right and left as employed in the text of the foregoing description refer to the sketch The directions are reversed in the actual specimen)

Fig 8 A Specimen 8 Showing the layers of muscle fibers encircling the anus posteriorly, the wide space between the coccyx and external sphincter through which the ischioanal fossae communicate, and the area of scar tissue between the anus and vagina

Miles, could be substantiated, the lymphatic path in cases of ischioanal abscess would be obvious Unfortunately, anatomical works and the results of this study fail to substantiate the finding However, organisms, once having gained the submucosal space, whether through ulceration, injury, fecal stagnation, or pure penetration, should find no difficulty in reaching the poorly nourished fatty areas in the anal triangle by merely following the perivascular spaces Once having found a locus minoris resistentiae, they can form an abscess which may or may not be associated with a fistula

What anatomical information can one obtain by anal palpation?

With the index finger in the anus and the thumb outside of the anus, one can feel the internal sphincter as a distinct band in most cases There is little doubt that many erroneous conceptions of the anatomy of the external sphincter are due to confusion between the two In many cases the so called Pecten band incised for the cure of fissure is none other than the internal sphincter

The fat filled ischioanal fossa interposes an additional barrier to palpation laterally, and, posteriorly, the palpating fingers grasp not

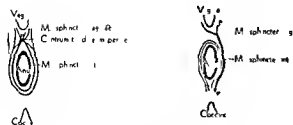


Fig 9. Specimen 9. Female aged 8 years. Death from military tuberculosis and tuberculous meningitis. Left figure the superficial fibers of the sphincter ani externus encircle the anus posteriorly on their way to and from the centrum tendineum perinei and the areas posterolateral to the vagina. The latter fibers may cross anterior to the anus. Right figure the deep fibers of the sphincter ani externus spread out over the fibers of the levator ani muscles and continue to the lateral aspects of the coccyx by fibrous extensions (anococcygeal raphe). A small number of fibers encircle the anus anteriorly and extend posteriorly into this anococcygeal raphe. About three times as many fibers arise from the anococcygeal raphe and extend anteriorly to insert into the posterolateral vagina area of the same or opposite side. The levator ani fibers surround the anus posteriorly and continue anteriorly as shown by the broken line *P—P*. The fibers converge a bit toward the centrum tendineum perinei but there is no striated muscle notable between the rectum and vagina. The anococcygeal raphe is poorly developed and superimposes the levator ani muscles such that the usual type of posterior communication does not exist between the ischio-rectal fossae. However since the fibers of the superficial layer of the external sphincter are the most numerous and extend quite some distance below the level of the coccyx the communication is superficial to the anococcygeal raphe. The sphincter ani internus is 1 millimeter thick and 4 millimeters broad. The muscle extends to the level of the anocutaneous junction. The muscle area posterolateral to the vagina is not separable into components. Terminations of longitudinal bowel fibers pass into the levator ani and a layer 1 millimeter thick separates the anal sphincters anterolaterally. Even more notable are these fibers at the anterior and posterior commissures where they pass into the centrum tendineum perinei and the anococcygeal raphe respectively. The posterolateral quadrants of the anal outlet are practically devoid of longitudinal fibers.

only the anococcygeal raphe and the underlying fat filled posterior communicating space, but also the combined levator ani and recto-coccygeus muscles as they arise from the coccyx. The external anal sphincter does not arise from the tip of the coccyx but from the sides, or, its attachment to the coccyx may be almost negligible, as previously described (see Fig 13). The accurate determination of the anatomy of the external anal sphincter clinically by palpation is, therefore, a doubtful matter. A survey of the sketches 1 to 13, inclusive, discloses that the external anal sphincter possesses no fixed anatomy, that its

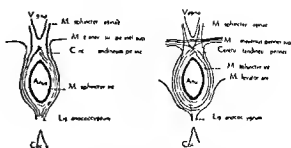


Fig 10. Specimen 10. Nulliparous female aged 27 years. Death due to bronchiectasis and pneumonia. Left figure the superficial layer of the sphincter ani externus arises in the anococcygeal raphe and passes forward to the musculus sphincter vaginae and musculus transversus perinei superficialis of the same side or to the centrum tendineum perinei. Fibers also arise at the centrum tendineum perinei and after encircling the anus posteriorly, pass forward deep to the whole sphincter ani externus to continue with the fibers of the levator ani. Right figure the deep layer of the sphincter ani externus consists of fibers which are the mirror image of the last described superficial fibers. Both the superficial and deep sets of these fibers receive longitudinal bowel fibers as they encircle the anus posteriorly. In addition fibers of the deep layer encircle the anus posteriorly in considerable numbers on their way to and from the musculus transversus perinei superficialis and musculus sphincter vaginae. The anococcygeal raphe is well developed and the ischio-rectal fossae communicate by a posterior space deep to it. The sphincter ani internus is 1 millimeter thick and a centimeter wide. The musculus transversus perinei superficialis is well developed and possesses fibers which pass directly across the midline. Terminations of longitudinal bowel fibers are numerous anteriorly and posteriorly at the anal outlet.

layers do not encircle the anus as closed rings nor do they consist purely of anteroposteriorly extending layers. The muscle usually consists of a variety of fibers which either encircle the anus anteriorly or posteriorly, or extend anteroposteriorly. The central tendon of the perineum serves as a fixed point, protecting the function of the anal sphincter by isolating it from perineal tears of childbirth and incisions through the perineum for prostatic and seminal vesicle operations. Von Frankl Hochwart and Froehlich determined that the external anal sphincter plays only a one third to one half part in the entire closing tonus of the anus. Matti estimated the importance of the external sphincter as 60 to 65 per cent, since, when its influence is removed, the internal sphincter acts peristaltically and maintains only a transitory resistance to a dilating force. By palpation of the internal sphincter, one may deduce facts regarding the external sphincter which may not be directly palpable.

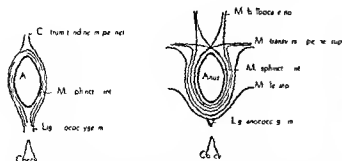


Fig. 11 Specimen 11 Male aged 30 years. Death due to pulmonary tuberculosis. Left figure: superficial layer of the sphincter ani externus. Lateral fibers comparatively few in number arise from the skin underlying centrum tendineum perinei, and musculus bulbocavernosus and extend posteriorly into the anococcygeal raphe. The greater number of superficial fibers surround the anus anteriorly and pass posteriorly into the anococcygeal raphe. Right figure: the deep fibers of the sphincter ani externus encircle the anus posteriorly and pass into the musculus levator ani, the musculus transversus perinei superficialis of the same or opposite side, the musculus bulbocavernosus of the same or opposite side, or the centrum tendineum perinei. The definition between superficial and deep layers is very difficult, many fibers pass from one layer to the other. The anococcygeal raphe is only fairly well developed, but the posterior space connecting the ischio-rectal fossae is well pronounced. The sphincter ani internus is 5 millimeter thick and firmly bound to the sphincter ani externus through longitudinal bowel fibers. Terminations of longitudinal bowel fibers are especially numerous at the anterior and posterior commissures.

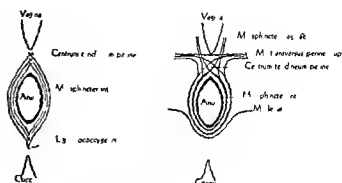


Fig. 12 Specimen 12 Female aged 42 years. Death due to pulmonary gangrene following a cholecystectomy. Left figure: the superficial layer of the sphincter ani externus consists of only a few fibers extending from the skin and underlying centrum tendineum perinei around the anus to the skin and underlying anococcygeal raphe. Right figure: the fibers of the deep layer of the sphincter ani externus encircle the anus posteriorly and pass to the levator ani of the opposite side, the musculus transversus perinei superficialis of the same or opposite side, or the musculus sphincter vaginae of the same or opposite side. The anococcygeal raphe is poorly developed. It contains only a few muscle fibers. The ischio-rectal fossae are connected by a posterior communicating space. The sphincter ani internus is 0.7 millimeter thick and 1 centimeter wide. The musculus transversus perinei superficialis is fairly well developed. It possesses fibers which pass directly across the midline as well as some which are lost in the scar tissue anterior to the anus.

Does the anatomy of the sphincter muscles account for the possibilities of incontinence following dilatation or cutting of the sphincters?

In dilatation of the sphincter, introduced by Recamier (Esmarch, 20), excessive vigor, rapidity, and light anesthesia are undoubtedly contributing factors to injury. Textbooks caution the operator not to dilate antero-posteriorly, but from side to side. Experience has no doubt sponsored this precaution and one may readily conceive the effect of an injury to the central tendon of the perineum from behind, knowing the effect of an anterior tear. Further, one may conceive how even side to side dilatation in Specimens 2, 8, and 12 might affect continence, especially if the internal sphincter be injured during the procedure, as is likely in cases in which the internal sphincter fails to form a complete circle (Specimen 4). Partial and permanent sphincter injury following dilatation has been observed by Melchior, Clairmont, and others.

That incision of the external sphincter is liable to be followed by interference with con-

tinence, is a fact quite generally conceded. In spite of the enthusiasm of Gant for the procedure, he admits that 1 per cent of 1,000 private cases and less than 5 per cent of 1,000 clinic cases of fistula developed postoperative fecal incontinence. Esmarch felt that the poor results following cutting of the sphincter were not due to injury of the muscle itself but to cutting of motor nerves through oblique or numerous incisions, since the motor nerves enter the muscle in several places. To substantiate this conception, he referred to cases in which continence returned a year after the operation when the nerve had had time to regenerate. The anatomical basis for this theory is correct, since this study has shown that unlike the ordinary nerves to skeletal muscle the nerve fibers parallel the muscle fibers but very short distances. However, the conclusions are erroneous, since physiological work previously described demonstrated the existence of a tonus center within the muscle, since it contracts as a whole when stimulated, and does not degenerate when its nerves are cut. The loss of a part of its motor nerve



Fig 9. Specimen 9. Female aged 8 years. Death from military tuberculosis and tuberculous meningitis. Left figure the superficial fibers of the sphincter ani externus encircle the anus posteriorly on their way to and from the centrum tendinum perinei and the areas posterolateral to the vagina. The latter fibers may cross anterior to the anus. Right figure the deep fibers of the sphincter ani externus spread out over the fibers of the levator ani muscles and continue to the lateral aspects of the coccyx by fibrous extensions (anococcygeal raphe). A small number of fibers encircle the anus anteriorly and extend posteriorly into this anococcygeal raphe. About three times as many fibers arise from the anococcygeal raphe and extend anteriorly to insert into the posterolateral vagina area of the same or opposite side. The levator ani fibers surround the anus posteriorly and continue anteriorly as shown by the broken line *P-P*. The fibers converge a bit toward the centrum tendinum perinei but there is no striated muscle notable between the rectum and vagina. The anococcygeal raphe is poorly developed and superficial. It poses the levator ani muscles such that the usual type of posterior communication does not exist between the ischio-rectal fossae. However since the fibers of the superficial layer of the external sphincter are the most numerous and extend quite some distance below the level of the coccyx the communication is superficial to the anococcygeal raphe. The sphincter ani internus is 1 millimeter thick and 4 millimeters broad. The muscle extends to the level of the anocutaneous junction. The muscle area posterolateral to the vagina is not separable into components. Terminations of longitudinal bowel fibers pass into the levator ani and a layer 1 millimeter thick separates the anal sphincters anterolaterally. Even more notable are these fibers at the anterior and posterior commissures where they pass into the centrum tendinum perinei and the anococcygeal raphe respectively. The posterolateral quadrants of the anal outlet are practically devoid of longitudinal fibers.

only the anococcygeal raphe and the underlying fat filled posterior communicating space, but also the combined levator ani, and recto-coccygeus muscles as they arise from the coccyx. The external anal sphincter does not arise from the tip of the coccyx but from the sides, or, its attachment to the coccyx may be almost negligible, as previously described (see Fig 13). The accurate determination of the anatomy of the external anal sphincter clinically by palpation is, therefore, a doubtful matter. A survey of the sketches 1 to 13, inclusive, discloses that the external anal sphincter possesses no fixed anatomy, that its

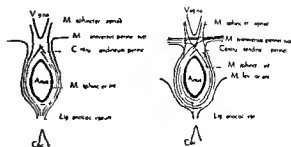


Fig 10. Specimen 10. Nulliparous female aged 27 years. Death due to bronchiectasis and pneumonia. Left figure the superficial layer of the sphincter ani externus arises in the anococcygeal raphe and passes forward to the musculus sphincter vaginae and musculus transversus perinei superficialis of the same side or to the centrum tendinum perinei. Fibers also arise at the centrum tendinum perinei and after encircling the anus posteriorly pass forward deep to the whole sphincter ani externus to continue with the fibers of the levator ani. Right figure the deep layer of the sphincter ani externus consists of fibers which are the mirror image of the last described superficial fibers. Both the superficial and deep sets of these fibers receive longitudinal bowel fibers as they encircle the anus posteriorly. In addition fibers of the deep layer encircle the anus posteriorly in considerable numbers on their way to and from the musculus transversus perinei superficialis and musculus sphincter vaginae. The anococcygeal raphe is well developed and the ischio-rectal fossae communicate by a posterior space deep to it. The sphincter ani internus is 1 millimeter thick and 2 centimeters wide. The musculus transversus perinei superficialis is well developed and possesses fibers which pass directly across the midline. Terminations of longitudinal bowel fibers are numerous anteriorly and posteriorly at the anal outlet.

layers do not encircle the anus as closed rings, nor do they consist purely of anteroposteriorly extending layers. The muscle usually consists of a variety of fibers which either encircle the anus anteriorly or posteriorly, or extend anteroposteriorly. The central tendon of the perineum serves as a fixed point, protecting the function of the anal sphincter by isolating it from perineal tears of childbirth and incisions through the perineum for prostatic and seminal vesicle operations. Von Frankl Hochwart and Froehlich determined that the external anal sphincter plays only a one third to one half part in the entire closing tonus of the anus. Matti estimated the importance of the external sphincter as 60 to 65 per cent, since, when its influence is removed, the internal sphincter acts peristaltically and maintains only a transitory resistance to a dilating force. By palpation of the internal sphincter, one may deduce facts regarding the external sphincter which may not be directly palpable.

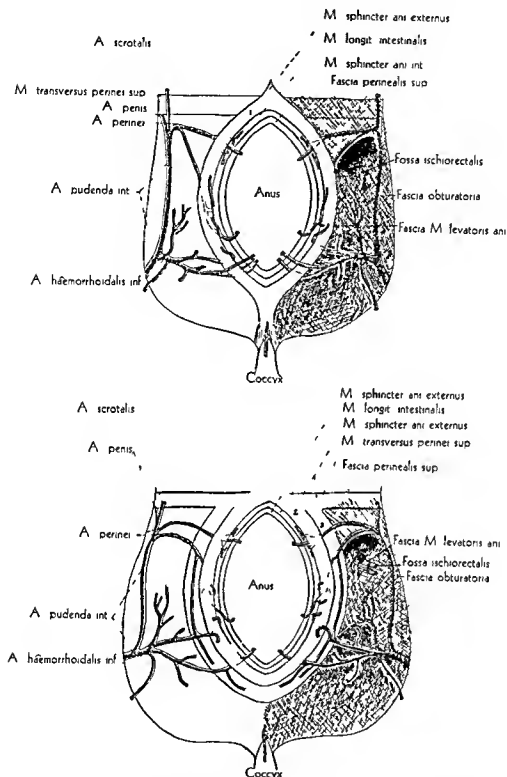


Fig 15 Specimen 4 Arteries of the anal triangle A, above, superficial, and B, deep views The numbers 1, 2, and 3 designate the relative depths of the fibers of the sphincter ani externus from 1, superficial, to 3, deep Note that the anterior two thirds of this muscle and the anal outlet are supplied by the arteria perinei and that the inferior hæmorrhoidal vessels passing to the submucous layer of the anus do so at points corresponding to approximately 5 and 7 on the clock Note also that the inferior hæmorrhoidal vessels pierce the ischiorectal fossa with the exception of one division which lies under the obturator and levator ani fasciæ whereas, the arteria perinei passes from the arteria pudenda inferior to the external sphincter and anus through the superficial perineal space almost completely isolated from the ischio rectal fossa

ani muscle Treitz described its effect as an increase in the anterior angulation of the bowel at the recto anal junction, thus constricting the bowel transversely

Does the anatomy of the external sphincter account for the etiology of anal fissure as advocated by Mummery?

Anal fissure, first accurately described by Boyer, in 1818, has been described as a superficial ulcer, occurring in the vicinity of the posterior commissure in men in 90 per cent of the cases and in women in 60 per cent of the cases (Hirschman) Quenu and Hartman describe an inflamed nerve filet lying deep to the ulcer in certain cases The etiological basis for simple or single ulcer has been ascribed by Gant to trauma initiated by constipation, evacuation of hardened feces, tearing down of a crypt of Morgagni (Ball), careless digital or instrumental examination, passage of foreign bodies swallowed, birth injuries, division of the sphincter, pessaries, careless introduction of enema tubes and instruments prostatic massage, and pederasty Baker Brown in 1864, who attributed anal fissure to onanism in women demonstrated that irritation of the clitoris produced fairly strong contractions of the anal sphincter with the patient under chloroform anesthesia Quenu and Hartman believed that hemorrhoids played an important etiologic rôle in fissure

The posterior location of fissure described by DaCosta, Esmarch, Gant, Hirschman, Mummery, Rotter, and others has been attributed to "the fact that on account of the concavity of the sacrum the curvature of the rectal and anal canal is such that the greatest force during the expulsion of the stool is toward the posterior commissure, also it must be remembered, that some of the fibers of the sphincter ani muscle parallel each other to the coccyx, and this is the direction of the anal line of cleavage" (Hirschman) Mummery explains the posterior location as follows "It has always seemed to me that the explanation is to be found in the structure of the external sphincter muscle itself This muscle is not, as has often been supposed, a circular muscle, but consists of a band of muscle fibers arising from the coccyx, which passes forward and splits to surround the anus, in front it is partly

inserted into the perineal point and partly continuous with the opposite side The external sphincter muscle is, therefore, not really a circular muscle, but consists of two lateral halves In front these halves are almost continuous but posteriorly for the most part placed parallel with each other From the arrangement of the fibers of the external sphincter, it will be seen that the mucous membrane and skin of the anal canal are best supported at the sides, and least supported at the posterior commissure, but the next weakest place being the anterior commissure In women, owing to the presence of the vagina, the anterior commissure receives less support than is the case in men If, therefore, the anus is stretched unduly, the point at which it gives way is the posterior commissure, and the next weakest place is the anterior commissure, since only some of the fibers are circular here A further proof that this is the true explanation of the formation of a fissure is afforded by the fact that when the mucous membrane of the anal canal gives way during the process of stretching the sphincter—an accident that may easily happen if the stretching be done too quickly—it always does so at the posterior commissure, showing that this is the weakest point of the muscle If the sphincter ani is forcibly stretched in the cadaver, it will be found that tearing always occurs posteriorly "

A review of the Figures 1 to 13, inclusive, will show that the argument of Mummery is based on a wrong premise, namely, the constancy of the anatomy of the external anal sphincter The ancient and mediæval conception of the fundamental pathology as "anal cramp" or spasm of the internal sphincter, whether primary or secondary, has more than a grain of reason to it as demonstrated by the successful results obtained by mere incision of this muscle, though it be mistaken for the so called pecten of Stroud by some surgeons The relationship of the sex organs to sphincter spasm demonstrated by Brown probably plays a greater rôle than has been generally conceded, since the disease is most common during adult life, although found in children addicted to pederasty The firm fixation of the posterior commissure and to a

lesser extent the anterior by the fibro elastic terminations of the longitudinal bowel coat plus the lateral free mobility of the mucous coat probably play a greater rôle in the etiology of anal fissure than does the contour of the external anal sphincter

The late Dr L A Greensfelder, with whom I had the good fortune to be associated, felt quite convinced that he could trace a definite relationship between irritating breakfast foods, such as bran, and anal fissure

SUMMARY

The anatomy and physiology of the anal sphincters are reviewed historically as a basis for this study to explain the pathogenesis of anal fistula, abscess, fissure, and postoperative incontinence. The constant location of the internal opening of anal fistula at 5 or 7 o'clock is explicable by the arrangement of the vessels in the anal triangle, the infection following the perivascular spaces. The anatomy of the external sphincter alone does not explain the origin of fissure, but the great accumulation of fibro-elastic terminations of longitudinal bowel fibers fixing the anterior and posterior commissures is probably a factor. The anatomy of the external sphincter may account for incontinence following stretching or incision of the sphincter, since, when its influence is removed, the efficiency of the internal sphincter becomes reduced because the mechanical stimulus necessary for the maintenance of resistance to a dilating force is lacking. The external sphincter consists neither entirely of fibers encircling the anus nor of fibers extending anteroposteriorly, but is a mixture of the latter type with fibers encircling the anus either anteriorly or posteriorly, in varying proportions

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USE OF HYPERTONIC SODIUM CHLORIDE SOLUTIONS TO STIMULATE PERISTALSIS

THOMAS G. ORR, M.D., F.A.C.S., PAUL N. JOHNSTONE, M.D., AND RUSSEL L. HADLON, M.D.,
KANSAS CITY, KANSAS

University of Kansas School of Medicine Kansas City, Kansas

IN 1924, Hughson and Scarff noted the effect of intravenous sodium chloride on peristalsis. They used cats as experimental animals. As soon as a 30 per cent solution of sodium was injected intravenously, the intestine showed marked peristaltic activity. This activity persisted in some instances as long as 55 minutes. They noted the same effect with much less intensity when physiologic salt solution was used. These authors state that the use of hypertonic sodium chloride solutions injected intravenously furnish a distinctly reliable agent for promoting peristalsis in intestinal loops, which for some reason have lost their power of motor activity. In a study of the effect of several salts upon intestinal movements, Dreyer and Tsung noted that hypertonic solutions of sodium chloride caused an increase in intestinal movements. No effect was produced by the use

of isotonic sodium chloride. Carlson and Wangenstein show tracings of increased activity of the small bowel after injecting intravenously 15 cubic centimeters of 20 per cent solution of sodium chloride, but do not discuss the observation. Ross has shown both experimentally and clinically that hypertonic sodium chloride solution will produce active peristalsis. He recommends its clinical use.

In a recent series of experiments on dogs, we have compared the activity of the small intestine after giving intravenously physiologic sodium chloride solution, hypertonic sodium chloride solution, hypertonic glucose solution, and 4 per cent sodium bicarbonate solution. Our experiments were all conducted on the upper jejunum. A Thury-Vella loop was made about 18 inches long beginning about 6 inches below the ligament of Treitz.

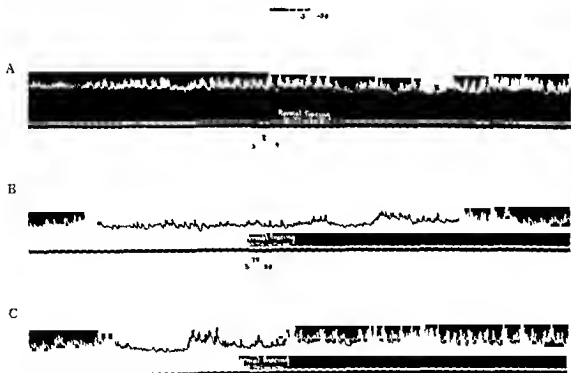


Fig. 1. Variations in the normal tracing of the jejunum. A, B, and C cover a period of one and one-half hours.

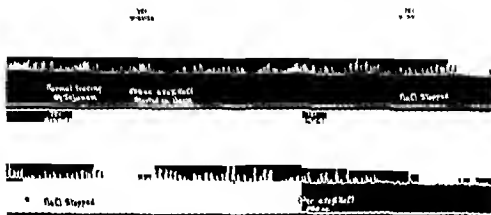


Fig. 2. Tracing of jejunum before and after intravenous administration of 85 per cent sodium chloride solution. No change is noted either in tone rhythm or peristalsis.

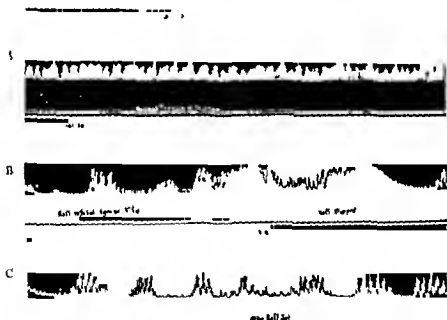


Fig. 3. Tracing of jejunum before and after intravenous injection of a 10 per cent sodium chloride solution 1 gram per kilogram of body weight. A Normal tracing. B Injection of salt solution, showing increase in tone and peristalsis. C Forty minutes after injection of hypertonic salt solution.

After complete healing had resulted following operation, tracings were begun. All tracings were made on kymograph records, a rubber bulb filled with air being used in the gut. In most cases the air pressure within the bulb and tube was kept quite uniform by measuring with a mercury column and marking on the kymograph drum before tracings were begun. Dogs were fasted for 36 hours before the

experiments so that the upper intestinal tract would be relatively empty.

EXPERIMENTAL RESULTS

After the intravenous administration of physiologic sodium chloride solution no change in the gut contractions was noted (Fig. 2). If hypertonic sodium chloride solution in 5 to 10 per cent strength was given,

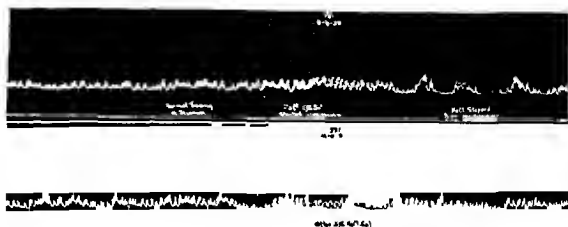


Fig 4 Tracing of jejunum before and after intravenous administration of 5 per cent sodium chloride solution, $\frac{1}{2}$ gram per kilogram of body weight. Slight increase in tone and peristalsis is noted.

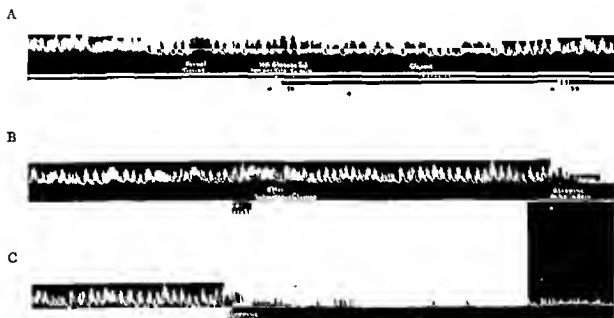


Fig 5 Tracing of jejunum before and after intravenous injection of 10 per cent glucose solution, 1 gram per kilogram of body weight. No change is noted after glucose injection. C, Atropine, grain $\frac{1}{50}$, intravenously injected causes almost immediate suspension of intestinal movement.

there always resulted an increase in the activity of the gut by raising the tone and starting active peristalsis (Figs 3 and 4). Hypertonic glucose solution had no appreciable effect upon the gut movements (Fig 5). A 4 per cent solution of sodium bicarbonate caused an almost immediate onset of active peristaltic waves that continued active for 30 to 45 minutes (Fig 6). Administration of an ether anaesthetic during a jejunal tracing im-

mediately stopped the rhythmic contractions. During anaesthesia hypertonic sodium chloride solutions did not stimulate peristalsis. After the ether was removed the contractions were resumed. Atropine likewise immediately stopped contractions.

SUMMARY AND CONCLUSIONS

Our experiments confirm the observations of others that hypertonic sodium chloride

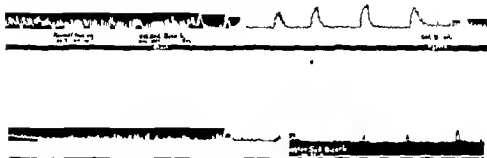


Fig 6 Tracing of jejunum before and after intravenous administration of a 4 per cent sodium bicarbonate solution, 1 gram per kilogram of body weight. An immediate development of marked peristalsis is noted after injection of the solution. This marked change lasted from 25 to 45 minutes following injection.

solutions stimulate peristalsis. We did not find, as did Hughson and Scarff, that physiologic sodium chloride solution caused a change in the activity of the intestine. The introduction of hypertonic sodium chloride solution into the bowel caused violent peristalsis in one of our animals with vomiting and defecation. Some of our animals had bowel movements soon after the injection of hypertonic sodium chloride solution. Some appeared to have discomfort as if the increased bowel activity caused colic.

From the clinical and experimental observations it seems probable that sodium chloride introduced into the body serves to (a) replace the chlorides lost in certain diseases such as intestinal obstruction, (b) probably is an active factor in water distribution in the body, (c) stimulates peristalsis and (d), by increasing the tone of the bowel, diminishes postoperative distention and ileus with its resultant anti peristalsis and vomiting.

A study of the action of physiologic sodium chloride solution, hypertonic sodium chloride

solution, hypertonic glucose solution and hypertonic sodium bicarbonate solution on peristalsis of the jejunum was made and the following conclusions reached. The stimulating effect of hypertonic sodium chloride solution upon peristalsis is further evidence of its value in the treatment of paralytic ileus and following operation for the relief of intestinal obstruction.

2 Further observation is necessary to determine the clinical value, if any, of sodium bicarbonate as a peristaltic stimulant.

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HYPERTROPHY OF THE PYLORIC MUSCLE IN ADULTS

C. C. McCLURE, M.D., CLEVELAND, OHIO
Cleveland Clinic

FIVE cases of a rather rare condition have come to my attention recently. Although the condition is but sparsely covered by the medical literature, is frequently undiagnosed or is erroneously diagnosed, oftentimes is not discovered until autopsy, and is of unknown and disputed etiology, yet it is responsible for severe and protracted symptoms, and sometimes even for death. The condition is variously designated by the few writers who have published reports of cases as chronic pyloric hypertrophic stenosis, chronic hypertrophy of the pylorus, congenital hypertrophic stenosis in adults.

Since the condition was first discussed by Maier in 1885, writers have disagreed regarding its etiology. Some contend that it is a continuation of the well known congenital stenosis (Fig. 1), which may have increased with growth, thus delaying the development of noteworthy symptoms. Some writers suggest that it may have been present in a latent form, active symptoms being produced perhaps by some infection, severe nervous strain, or other condition which has had a trigger effect. Others have adduced evidence suggesting an endocrine origin, Pirie believing that hyperadrenalism is the stimulus which brings on hypertrophy and stenosis. He contends, according to Chaney, that the secretory stimulation of the pancreas is inhibited by excessive adrenalism and that the lack in pancreatic secretion delays the neutralization of the acid chyme from the stomach, causing the pylorus to remain closed for an abnormal length of time, this closure in turn producing gastric retention and hyperacidity followed by pyloric hypertrophy. Chaney cites a case which was partially relieved by the administration of thyroid extract.

It is my own conception that chronic hypertrophic pyloric stenosis may possibly be the result of long standing spasticity of the pyloric muscle. In our cases, nervousness was a prominent symptom, and thus alone is

capable of producing a spasticity of the pylorus which if long continued might in turn cause hypertrophy of the spastic tissue. Archer, too, believes that spasm due to reflex irritation undoubtedly may be an etiological factor, and if long continued will lead to hypertrophy.

While undoubtedly the etiology of this disease is a fascinating theme for discussion and study, it is obvious that there is in these patients a definite pathological condition which is capable of causing severe symptoms, even though it may be present for some years before becoming serious, and the important matter, therefore, is its recognition and treatment. It is our earnest plea that clinicians as well as roentgenologists consider the possibility of the presence of hypertrophy of the pyloric muscle in all cases which present obscure epigastric symptoms. The fact that in most of the reported cases the condition has been recognized only at autopsy suggests that it is not so rare as the paucity of references in the literature would seem to imply. This fact is an indication, also, of the need for improved methods of diagnosis.

REPORT OF CASES

The first of the cases we have to present illustrates the type of pyloric hypertrophy which is either symptomless or in which the symptoms are overshadowed and obscured by those of other serious diseases, so that the muscular hypertrophy is not suspected until discovered at autopsy.

CASE 1. The patient was a woman, aged 55 years, who complained of goiter, heart disease, dyspnea, oedema, terrific coughing spells, nervousness, poor appetite, and loss of weight. Shortly after entering the hospital for treatment, and before there had been an opportunity to make a gastro intestinal examination, she died suddenly of myocardial degeneration and decompensation. An autopsy was performed, and the pathological diagnosis included 18 items, among them chronic cholecystitis with cholelithiasis, acute diffuse appendicitis, and hypertrophy of the pyloric muscle.



Fig 1 A case of congenital pyloric stenosis in a child 3 weeks old operated upon with resultant complete relief. Pathologically this condition is the same as that exhibited in hypertrophy of the pyloric muscle in adults.

Pathological examination of the gastro intestinal tract showed that the stomach was considerably contracted. The mucosa was grayish in color with normal rugations and velvety in consistency. No scars nor ulcers were found. The pyloric ring was markedly thickened and the musculature was hypertrophied throughout the fundus. Microscopic examination showed marked thickening of the mus-

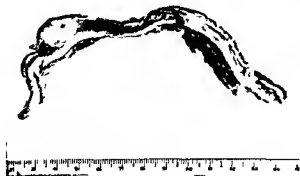


Fig 2 Hypertrophy of the pyloric muscle discovered at autopsy. The condition was not suspected before death, and a gastro-intestinal X-ray examination was not made. Case 1.



Fig 3 Roentgenogram showing a smooth filling defect of the pars pylorica interpreted before operation as carcinoma but proved on pathological examination to have been caused by hypertrophy of the pyloric muscle. Case 2.

cular coat of the pylorus, a few small areas of lymphocytic infiltration around the blood vessels and a slight increase of fibrous tissue in the lower layers of the mucosa. Otherwise the muscle tissue appeared to be practically normal (Fig 2).

The 3 following cases illustrate how easily a mistake may be made in diagnosis, yet without disastrous results. In two of these cases the condition appeared to be of the congenital type, since symptoms had been present practically from the beginning of life. In two of the cases the possible association of the condition with ulcer is also interesting. In Case 3 an ulcer developed after operation while in Case 4 there was pathological evidence of a healed lesion which may have been ulcer. This brings up the possibility of a common underlying factor in the production of hypertrophy and ulcer. Pine has suggested that hyperadrenalism is the stimulating element in hypertrophy, while Crile has advanced the theory that hyperadrenalism may be a factor in the production of ulcer. This is a fertile field for investigation.

CASE 2 The patient was a woman 36 years of age who gave a history of life long indigestion more



Fig. 4 above Photographs showing two views of the gross specimen after resection of the pylorus Case 2

Fig. 5 Photomicrograph showing section through the hypertrophied pyloric muscle Case 2 X 20

severe during the preceding 10 years and gradually growing worse. For the preceding 3 years she had had attacks of epigastric pain, usually developing immediately after eating and relieved by vomiting. During this period she had lost 65 pounds.

A ray examination of the stomach (Fig. 3) revealed a filling defect of the pars pylorica which was interpreted as due to carcinoma. The clinicians, however, believed it more probable that an ulcer was responsible, because of the duration of symptoms.

At operation, a marked thickening of the inferior portion of the pyloric ring could be felt, and apparently the lumen of the pylorus was very small as the fingers could not be passed through the ring. The lymph nodes along the greater curvature of the stomach seemed to be enlarged, but they were soft

and did not have the gross characteristics of metastatic involvement. Partial gastric resection and posterior gastrojejunostomy were performed.

When the stomach was opened for pathological examination, a thickening of the entire wall was found which was most marked at the pyloric end (Fig. 4), where the wall measured 8 millimeters in thickness. The mucous membrane was thickened and somewhat irregular, but no ulcer was found in the region of the pyloric ring. There were several polypi on the gastric mucosa and 6.5 centimeters from the pyloric ring a small necrotic area was seen which was possibly a beginning ulcer. Longitudinal section along the greater curvature revealed marked thickening of the pyloric muscle for a distance of 3 centimeters from the duodenum with increased fibrous tissue in the muscular coat. Both mucosa



Fig 6 Roentgenogram showing a constriction at the pyloric ring diagnosed before operation as congenital duodenal adhesions. This picture was made after the administration of atropine. Case 3

and submucosa were of the same thickness throughout. Microscopic examination of a section through the gastroduodenal junction (Fig 5) showed normal thickness of the duodenal wall, a slight diffuse inflammatory reaction in the mucosa, and hypertrophy of the superficial portions of the mucous glands. On the gastric side of the pylorus there was superficial ulceration of the mucosa, with atrophy of the gland and a diffuse inflammatory reaction in the mucosa and submucosa. The muscular wall of the stomach was greatly thickened. There were no enlarged lymph glands and no evidence of malignancy or ulcer. The pathological diagnosis was chronic gastritis and hypertrophy of the muscular coat in the pyloric region.

Despite the continuing development of hyperthyroidism and anemia after operation, the patient gained 43 pounds in 15 months and the gastrointestinal symptoms disappeared except such as could be attributed to her other conditions.

CASE 3. The patient was a woman, 44 years of age, who had suffered with indigestion and constipation practically all her life, but the symptoms had become worse during the preceding 2 years, with extreme distention and diffuse discomfort in the abdomen, especially the epigastrium, which developed about 3 hours after meals. Relief was obtained from food or alkalies, and the symptoms had been quiescent while the patient was on a Sippy diet and also while the diet was confined to vegetables. Physical examination revealed slight tenderness on deep palpation in the midepigastrium.



Fig 7 Cross specimen removed from pyloric end of stomach, showing hypertrophy of the pyloric muscle. Case 3

The first X-ray diagnosis was probable gastric ulcer, but after the administration of atropine to the physiological limit the diagnosis was changed to congenital duodenal adhesions (Fig 6).

At operation an irregular thickening of the pylorus was found on its posterior surface toward the gastric side. It was impossible to determine whether or not ulcer was present, but partial gastric resection and gastrojejunostomy were decided upon because it was believed that the pyloric end of the stomach was diseased. The patient had a satisfactory operative recovery.

The pathological diagnosis was pyloric stenosis due to hypertrophy of the pyloric muscle. Grossly the pyloric band appeared somewhat thickened (Fig 7). The mucous membrane did not show any areas of ulceration. Microscopically (Fig 8), section of the stomach wall in the pyloric region showed thickening of the gastric mucosa, with diffuse increase of fibrous tissue and interglandular stroma. There was marked thickening of the muscular coats of the pyloric vein. No evidence of neoplasm, ulcer, or active inflammatory reaction was found.

Sixteen months later the patient returned complaining of headache, gastric discomfort and constipation. Roentgenographic examination showed that the stomach emptied readily through the artificial opening, but a 5 hour film showed retained barium at the gastroenterostomy. An X-ray diagnosis of marginal ulcer was made and medical treatment was advised. The patient has not been seen since.

CASE 4. The patient, a man 45 years of age, complained of intermittent attacks of epigastric pain beginning at the age of 12 years. The pain occurred between meals and sometimes was accompanied by nausea and vomiting. For one period of 6 years he had been free from attacks, but part of this time he was under treatment for pulmonary tuberculosis, which finally was pronounced arrested. Six years before our examination the pain had returned with increasing severity and a modified Sippy diet had given no relief.

Physical examination revealed spasticity of the abdominal muscles over the epigastrium and tenderness in the midline 3 centimeters below the xiphoid process. The X-ray diagnosis was duodenal ulcer without obstruction but with deformity of the duodenal bulb (Fig 9).

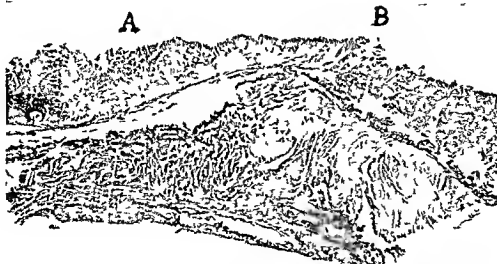


Fig 8 Photomicrograph showing normal muscle tissue at A and hypertrophied pyloric muscle at B Case 3 $\times 10$

At operation, the region of the pylorus was explored, and a large ulcer was thought to be present because of the amount of scar tissue on the gastric side of the pyloric vein. Gastric resection and gastrotomy were performed, and the patient made a satisfactory recovery.

The pathological diagnosis was cicatricial stenosis of the pylorus and hypertrophy of the pyloric muscle. Grossly no scars were recognized. The pyloric wall was somewhat thickened, and there was a ringlike constriction. When the stomach was opened along the lesser curvature, a localized thickening was found at the pylorus. The mucosa of the stomach and duodenum appeared practically normal, and no active ulcers or scars were recognized (Fig 10). Microscopically, sections of the pyloric region showed thickening of the stomach wall and a large amount of muscular tissue. There was no inflammatory exudate or scarring in the muscle. The submucous coat was not especially thickened. In the mucosa there was considerable lymphoid tissue, diffuse round cell infiltration, diffuse fibrosis of the interglandular stroma, and numerous eosinophils. The mucous glands were somewhat swollen but otherwise normal. Fibrosis and thickening of the submucous coat was most marked at the junction of the stomach and duodenum (Fig 11).

Our fifth case illustrates the possibility of erroneous diagnosis when examination is made with the patient in only one position. Had examination in this case been made with the patient in only the upright posture, the pyloric defect could not have been observed.

CASE 5 This patient was a man, 31 years of age. Eighteen months before we first examined him following some business reverses, his stomach had become sour and generalized abdominal soreness

and tenderness had developed with vomiting when the pain became severe. The patient had lost 15 pounds in weight during this period. A gastric analysis 6 months after the development of symptoms had demonstrated hyperacidity. No tumor masses or tenderness had been felt in the abdomen, and the impression was that the patient was suffering from colitis and nervous hyperacidity. The only positive roentgenographic finding was reverse peristalsis in the duodenum and an unusually



Fig 9 Roentgenogram showing a filling defect of the pylorus, diagnosed before operation as due to ulcer Case 4



Fig. 10 Two views of gross specimen after resection of the pylorus Case 4

large gas bubble in the stomach. At this time the patient was treated medically.

Twelve months later he returned with no abatement of symptoms. The X-ray findings were similar to those of the previous year. Repeated changes of medication were made during the 3 years following X-ray examination. At the end of this period showed that the stomach was ptotic and dilated, that the duodenal bulb was slow in filling but regular and that there were bands holding the second portion of the duodenum above the duodenal bulb.

Seven months after this examination the X-ray picture suggested the presence of chronic hypertrophic stenosis of the pylorus. With the patient in the erect posture the meal entered the stomach without delay. The stomach occupied a normal position and no deformity was apparent. The duodenal bulb filled smoothly. With the patient in the prone posture the picture was somewhat different. There was a narrowing of the pars pylorica for an inch and a half. This was constant throughout as is shown in Figure 12. On a second fluoroscopic examination with the patient in the vertical position the narrowing had disappeared. In the horizontal position it reappeared but steady, gentle pressure produced a smooth appearance of the pylorus. There was some retention at the end of 5 hours.

It is apparent that the weight of the barium meal was sufficient to overcome the muscular constriction when the patient was upright. When he lay down however the hypertrophied muscle could assume its usual position. The constriction was smooth and would not be easily mistaken for a malignant lesion,

especially since a filling defect was not constantly present. In such an examination it is essential that the patient be placed in a position which will eliminate deformity as a result of pressure from the spine.

The diagnosis at this time was hypertrophy of the pyloric muscle, and an exploratory operation was advised which has not been performed up to the time of this writing.

CASES REPORTED IN THE LITERATURE

As has already been stated, a review of the recent literature on this subject discloses a great paucity of material. Morton recently has reported 3 cases in each of which roentgenological studies of the gastrointestinal tract disclosed characteristic changes in the pylorus while exploration of the abdomen revealed hypertonicity and hypertrophy of the pylorus with narrowing of its lumen. In each case there was soreness of the abdomen, nausea and vomiting, and loss of weight. In none was there a palpable mass in the abdomen. Two of these patients were treated by plastic operation and were completely relieved of all symptoms. The third was treated by manual dilatation of the pylorus, and was only partially relieved for a time.

Archer has described 3 cases in which hypertrophy of the pyloric muscle was found

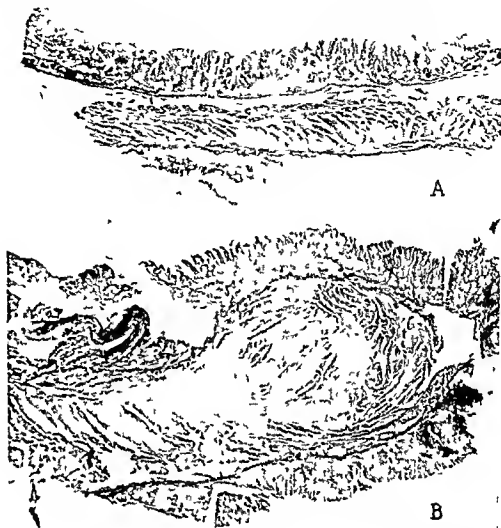


Fig. 11. Photomicrograph showing two views of the pyloric muscle: normal muscle, A, and hypertrophied muscle B. Case 4. $\times 10$.

at operation. The pre-operative diagnoses were respectively carcinoma, ulcer, and chronic appendicitis. In the last case, diagnosis on roentgen examination after appendectomy was "probable small ulcer." The duration of symptoms before advice was sought varied from 5 months to 1 year. A Rammstedt operation was performed in one case, the symptoms being mitigated, although the patient still has occasional nausea associated with fatigue but no vomiting. In the second case the pylorus was stretched manually. The patient improved after operation, but 5 months later the symptoms returned and pyloroplasty was advised. In the third case the anterior portion of the pyloric musculature was removed and a pyloroplasty was performed after the method of Horsley, Judd,

and others. After operation this patient enjoyed the best health she had ever known.

Chaney, in 1928, reported a case in which, added to the usual symptoms, were jerky movements in the limbs, fine intermittent tremors of the head, especially involving the lips, difficulty in speech, slight protrusion of the eyeballs, and discoloration of the skin about the elbows, knees, and mouth. Despite a normal basal metabolic rate, thyroid extract was administered until the rate rose to 32 per cent, when the nervous manifestations disappeared. Pyloroplasty completely relieved all symptoms.

Crohn, in 1928, described a case which undoubtedly was congenital, since the symptoms had been present even in infancy, and had been mitigated by a low residue diet.



Fig 12 Roentgenogram showing hypertrophy of the pyloric muscle. The presence of this condition has not as yet been confirmed by operation. Case 5

This patient was cured by a retrocolic posterior gastrojejunostomy.

Ackman, in 1929, reported a most unusual case of congenital hypertrophic pyloric stenosis in a man aged 72 years. He had suffered from "stomach trouble" all his life and finally died of inanition as a result of vomiting due to narrowing of the pylorus. At autopsy the lumen was found to measure less than 3 millimeters.

In none of these cases, and in none of our own, was it possible to demonstrate clinically a palpable mass in the abdomen.

On gastric analysis the findings varied from anacidity to hyperacidity, so that deductions as to the role of acidity cannot be drawn. Infection was present in only 2 cases, and blood was found in the gastric secretion in only 2 cases. In none was there an ulcer found at time of operation.

CONCLUSIONS

Patients afflicted with pyloric stenosis present a varied and at times pitiful clinical picture. They seek aid from various physicians and are subjected to numerous roent-

genological examinations, each physician feeling that ulcer or malignancy should be demonstrated, and when a negative report is returned, usually the condition is diagnosed as "nervous indigestion," and the common medications are prescribed, with very little resultant relief. When the true condition finally is diagnosed, relief really is in sight, for a plastic operation will give these people a new lease on life.

To prevent an erroneous diagnosis, it is important to differentiate this condition from a spastic pylorus. This may be done by the administration of atropine, preferably hypodermically. If the deformity seen roentgenologically is due entirely to pylorospasm, sufficient atropine will relax the musculature. If it is produced by hypertrophy of the pyloric muscle, even though the atropine will relax any accompanying spastic condition of the thickened muscle, it will not cause complete disappearance of the pyloric constriction.

While recognizing the interest and importance of determining the etiology of pyloric stenosis in adults, we urge the greater need of its recognition in every case in which it is present, and its appropriate treatment by a sufficiently radical operative procedure. Palliation by medical treatment only postpones the day when operation is imperatively required and prolongs the patient's sufferings.

NOTE.—Grateful acknowledgment is made of the assistance of Dr. Allen Graham in supplying pathological findings and photomicrographs illustrating these interesting cases.

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THE EFFECT OF EPHEDRIN ON THE CIRCULATION OF DOGS DURING SPINAL ANÆSTHESIA

JOHN C BURCH, M D, F A C S AND T R HARRISON, NASHVILLE, TENNESSEE
From the Departments of Gynecology and Medicine of Vanderbilt University

SINCE its introduction as a corrective measure for the fall in blood pressure occasioned by the use of spinal anæsthesia ephedrin has been extensively used

In previous publications concerning the physiology of spinal anæsthesia we have shown that the fall in blood pressure which occurs as a result of the diminished peripheral resistance may be followed by diminished cardiac output. The diminution in cardiac output is not great until the pressure begins to reach relatively low levels (2). It was also demonstrated by Burch, Harrison, and Blalock (3) that animals in which spinal anæsthesia has been induced, stand hæmorrhage poorly. This is a result of vasomotor weakness. It is well known that one of the compensatory mechanisms for hæmorrhage is vasoconstriction. We have demonstrated that in dogs under spinal anæsthesia the vasoconstriction response to hæmorrhage is absent (4). Hence, during spinal anæsthesia the mechanism compensating for hæmorrhage is disturbed.

Fluid as a corrective measure has been studied (5), and it seemed worth while to us to investigate also the effect of ephedrin on the circulatory system during spinal anæsthesia.

Dogs were anæsthetized with barbital. A carotid cannula was inserted and was connected to a mercury manometer. The technique used for the measurements of arterial tone and of cardiac output have been described in our previous papers.

Spinal puncture was usually done in the upper lumbar segment and we have experienced no great difficulty in doing this on most anæsthetized dogs. Ephedrin was given intravenously and intraspinally in doses of 2 to 5 milligrams per kilogram of body weight.

In Table I are shown the effects of injecting ephedrin into the blood stream. The mean blood pressure increased in each instance, the degree of increase being most marked when the pressure was not extremely low before the

drug was given. In no instance did the mean blood pressure rise to a level above the original control value before spinal anæsthesia had been induced. The cardiac output was usually much increased after ephedrin, and the degree of increase was usually greater than that found in normal dogs by Wilson, Pilcher, and Harrison (6). The rises in cardiac output and blood pressure were sustained for 30 minutes or longer in most of the experiments.

The results of the administration of ephedrin intraspinally are shown in Table II. When ephedrin was given intraspinally to a dog which had previously received spinocaine, the blood pressure rapidly rose to a value equal to or above the normal pressure for that animal. The subsequent administration of large amounts of spinocaine caused no decrease in blood pressure, although most of the animals died of respiratory paralysis after receiving extremely large doses of spinocaine. When ephedrin was administered prior to spinocaine no decline in blood pressure occurred even though successive large doses of spinocaine were given.

These data seem to indicate that in dogs ephedrin intraspinally is superior to ephedrin intravenously in the prevention of the fall in blood pressure caused by spinal anæsthesia. The exact nature of the pharmacological action of ephedrin in this connection is not clear. Possibly the effect is due to absorption of the drug from the spinal fluid into the blood stream over a considerable period, possibly to an action on vasomotor fibers as they leave the cord.

The data in Table III show that the intravenous administration of ephedrin is followed by a marked decrease in perfusion rate, i. e., by an increase in arterial tone.

In Table IV are shown five experiments in which dogs under spinal anæsthesia were given ephedrin and then bled. The animals withstood withdrawal of from 15 to 40 cubic centimeters of blood per kilogram. It has been

TABLE I—THE EFFECT OF EPHEDRIN ON BLOOD PRESSURE AND CARDIAC OUTPUT

| Experiment number | Control period | After spinal anesthesia | | After ephedrin | | | Mode of administration of ephedrin |
|-------------------|---------------------------|---------------------------|--------------------------------|--------------------------------|---------------------------|--------------------------------|------------------------------------|
| | Mean blood pressure mm Hg | Mean blood pressure mm Hg | Cardiac output per minute c cm | Time after ephedrin in minutes | Mean blood pressure mm Hg | Cardiac output per minute c cm | |
| 15 | 146 | 56 | | 2 10 30 | 115 106 115 | | Intravenous |
| 16 | 121 | 70 | 1180 | 5 15 | 109 102 | 1550 1730 | Intravenous |
| 17 | 108 | 56 | 1120 | 7 50 | 107 87 | 1540 1930 | Intravenous |
| 18 | 116 | 59 | 850 | 15 | 70 | 850 | Intravenous |
| 19 | 124 | 34 | 1110 | 7 45 | 80 50 | 1780 2430 | Intravenous |
| 20 | 104 | 47 | 710 | 5 30 | 85 15 | 2130 810 | Intravenous |
| 21 | 85 | 34 | 230 | 12 45 | 65 84 | 2750 590 | Intravenous |

TABLE III—THE EFFECT OF EPHEDRIN INTRAVENOUSLY ON THE PERFUSION RATE OF THE HIND LEGS OF DOGS

| Experiment number | Before ephedrin | | After ephedrin | |
|-------------------|---------------------------|--------------------------------|---------------------------|--------------------------------|
| | Mean blood pressure mm Hg | Perfusion rate per minute c cm | Mean blood pressure mm Hg | Perfusion rate per minute c cm |
| 30 | 84 | 0.3 | 115 | 60 |
| 31 | 84 | 10.2 | 105 | 38 |
| 32 | 52 | 14.5 | 407 | 54 |

shown by Blalock (1) that normal dogs die when bled 30 to 50 cubic centimeters per kilogram of body weight. Burch, Harrison, and Blalock (3) found that dogs which were under spinal anesthesia and which had not received ephedrin died when bled 8 to 16 cubic centimeters per kilogram. Therefore ephedrin markedly decreases the susceptibility to hemorrhage of dogs under spinal anesthesia.

SUMMARY

1. Ephedrin *intravenously* caused a rise in the blood pressure and the cardiac output of dogs under spinal anesthesia.

2. Ephedrin *intraspinaly* caused an even greater rise in blood pressure. The previous administration of ephedrin intraspinaly abolished the usual vasomotor effect of spinocaine.

3. The arterial tone was increased in dogs by ephedrin.

TABLE II—THE EFFECT OF EPHEDRIN INTRASPINALY ON THE BLOOD PRESSURE

| Experiment number | Control period before spinal anesthesia—mean blood pressure mm Hg | After spinal anesthesia—mean blood pressure mm Hg | After ephedrin—mean blood pressure mm Hg | Remarks |
|-------------------|-------------------------------------------------------------------|---------------------------------------------------|---------------------------------------------------|------------------------------------------------------------------------------|
| 36 | 155 | 114 | 100 (10 min) 160 (1 hr) | Respiratory paralysis after 6 c cm spinocaine |
| 40 | 150 | 90 | 225 130 (10 min) | Respiratory paralysis after 2 c cm spinocaine |
| 41 | 97 | 64 | 90 (15 min) | |
| | | After ephedrin mean blood pressure mm Hg | After spinal anesthesia mean blood pressure mm Hg | |
| 52 | 102 | 106 | 118 | Total spinocaine—c cm 1 2 3 4 5 6 Respiratory paralysis |
| 55 | 140 | 136 | 135 134 135 135 133 136 | 1 2 3 4 5 6 Respiratory paralysis |
| 59 | 100 | 95 | 90 | |

TABLE IV—THE EFFECT OF EPHEDRIN ON THE SUSCEPTIBILITY TO HEMORRHAGE OF DOGS UNDER SPINAL ANESTHESIA

| Experiment number | Weight of dog kilograms | Total amount bled before death occurred c cm | Amount bled c cm per kilogram | Remarks |
|-------------------|-------------------------|----------------------------------------------|-------------------------------|------------------------|
| 16 | 10 | 300 | 30 | Ephedrin intravenously |
| 19 | 8 | 170 | 15 | Ephedrin intravenously |
| 21 | 10 | 315 | 31 | Ephedrin intravenously |
| 30 | 10 | 300 | 30 | Ephedrin intraspinaly |
| 40 | 15 | 600 | 40 | Ephedrin intraspinaly |

4. The administration of ephedrin to dogs under spinal anesthesia decreased the susceptibility of such animals to hemorrhage.

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CICATRICAL (BENIGN) STRICTURE OF THE OESOPHAGUS OF UNKNOWN ORIGIN

REPORT BASED ON FORTY CASES

PORTER P. VINSON, M.D., ROCHESTER, MINNESOTA

Division of Medicine The Mayo Clinic

ANY inflammatory reaction in or around the oesophagus may result in oesophageal stricture. The majority of cicatricial strictures are due to swallowing of some caustic substance such as household lye, whereas others have followed infections of childhood, typhoid fever, vomiting of pregnancy, and so forth.

After all the known causes of benign stricture of the oesophagus have been enumerated, there remains a fairly large group of cases in which there is no apparent etiological factor.

Oesophageal ulceration occurs more frequently than generally is recognized, but in most instances the inflammatory reaction is superficial, and when healing occurs the lumen of the tube is not reduced enough for dysphagia to be produced. Frequently considerable ulceration is encountered in the oesophagus, associated with an impacted foreign body, yet in only one instance have I observed development of stricture following removal of the foreign body.

Caustic substances seem to have the power to injure the deeper portions of the oesophageal wall, and a very small quantity of a solution of lye may produce multiple dense strictures, whereas strictures of ordinary inflammatory origin are usually single, short, and not particularly dense. So-called peptic ulcer of the oesophagus has been described, and one might attribute development of a benign stricture of the oesophagus to the healing of a lesion of this type, with secondary contraction of the lumen of the oesophagus. However, few of the patients who have strictures of unknown origin have had any symptoms preceding the onset of dysphagia, and most of them have not experienced pain or a substernal burning sensation after the onset of their illness. Since pain and substernal burning have been described as cardinal symptoms of peptic ulcer of the oesophagus, it is unlikely

that peptic ulcer is a common etiological factor in stricture.

The onset of dysphagia in the cases which form the basis of this report was usually insidious, but in one case it was sudden and followed a period of fever, associated with vomiting of pus and blood. It seemed in this case that it had resulted from healing of a mediastinal abscess. In one case stricture developed following an attack of acute suppurative appendicitis and in another case, previously reported (2), apparently perforation of the oesophagus developed following physical strain, and a mediastinal abscess and secondary stricture formed.

In a previous report (1) from The Mayo Clinic, of 186 cases of benign oesophageal stricture, 18 (less than 10 per cent) were of unknown



Fig. 1. Benign stricture of the oesophagus considered malignant on roentgenologic examination.

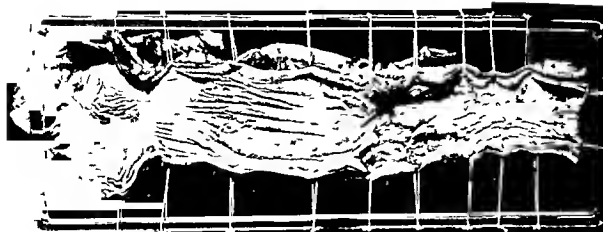


Fig. 2 Esophagus removed at postmortem examination. The patient succumbed to myocardial disease. The dysphagia was completely relieved by dilatation.

origin. Up to January 1, 1930, 243 cases of benign stricture of the esophagus were observed, and in 40 of these the cause of the stricture could not be determined. This represents a rather striking increase in the relative number of patients who have benign stricture of the esophagus of unknown origin and presents a problem in distinguishing this condition from malignant disease of the esophagus.

Seventeen of the 40 patients were males and 23 were females. The ages ranged from 6 to 75 years. In 9 cases the stricture was in the upper third of the esophagus (18 to 25 centimeters from the incisor teeth), in 10 cases, in the middle third (28 to 33 centimeters from the incisor teeth), and in 21 cases, in the lower third (35 centimeters from the incisor teeth to the cardia). The duration of symptoms was 6 weeks to 11 months in 8 cases, from 1 to 2 years in 10 cases, from 3 to 5 years in 10 cases, from 6 to 16 years in 6 cases, more than 17 years in 5 cases, and "many years" in 1 case.

Dysphagia was present in varying degree in all of the cases. In one case there was complete obstruction of the esophagus and gastrostomy had been performed elsewhere 18 years previously. As in other cases of benign stricture, the degree of dysphagia varied according to the size of the lumen of the stricture.

Pain was experienced by 24 of the patients but 5 had pain at the onset of symptoms only and 4 others did not note it, except during the

act of swallowing or when a bolus of food became obstructed at the site of the stricture. In 3 cases, the pain was similar to that experienced by patients who suffer from gastric or duodenal ulcer, and in two of these a duodenal ulcer was demonstrated on roentgenoscopic examination. The pain was relieved in most instances by dilating the stricture. The pain was attributed to associated esophageal spasm rather than to active ulceration in the esophagus. Regurgitation was frequent. Ten of the patients had noted blood in the material ejected from the esophagus, as a rule this was small in amount but one patient had vomited about 500 cubic centimeters of bright red blood.

Roentgenoscopic examinations of the esophagus were made in 38 cases, and in 7, obstruction was not detected. In 4 cases the obstruction was considered to be caused by a malignant lesion (Figs 1 and 2), in 1 case it was thought to be due to cardiospasm, and in 1 to pharyngoesophageal diverticulum. The stricture was single in all cases.

Eighteen of the patients were examined with the esophagoscope, and all the lesions appeared to be benign. Active ulceration was demonstrated in the scar in 2 cases, but in one of these the examination was made within a week after the stricture had been dilated, and it was considered to be traumatic in origin. A second examination at a later date revealed complete healing.

The insidious onset of oesophageal obstruction without apparent cause always suggests the presence of carcinoma and in every case this diagnosis was considered. Many of the patients had been given a diagnosis of oesophageal carcinoma before they came to the clinic for examination. One patient who had been given a hopeless prognosis had attempted suicide (Fig 3). The combination of a rather long history of dysphagia, without marked progression, in a case in which the patient is fairly well nourished always should suggest that the lesion is benign. If a careful roentgenoscopic examination fails to reveal obstruction or if the stricture produces a smooth outline, one has additional evidence that the obstruction is not malignant. If, also, the stricture is short and appears not to be malignant when it is observed through the oesophagoscope, it should be considered to be benign.

It is sometimes impossible to prove the presence of carcinoma by microscopic examination of tissue removed from the oesophagus. If one is inclined to advocate gastrostomy in the treatment of carcinoma of the oesophagus, it is likely that a needless operation of this type will be done on some of the patients who have benign stricture of unknown cause. However, if one recommends dilatation of malignant as well as of benign oesophageal strictures, it follows that all cases of benign stricture will be properly treated and that the elapse of sufficient time will settle any question as to the accuracy of the diagnosis. At any rate, one should never make an absolute diagnosis of oesophageal carcinoma unless the tissue which has been removed from the oesophagus has been proved to be carcinomatous by means of the microscopic examination of sections.

Thirty-nine of the patients were treated by dilatation, without a death and with excellent functional results. The strictures were gradually dilated to a size 45 F, with sounds passed over a swallowed silk thread. One of the patients had a complete stenosis of the oesophagus and therefore no attempt was made to establish an opening through the scar tissue.



Fig 3 Benign stricture of the oesophagus of unknown origin. Bullet is shown in the lung, the result of attempted suicide following a hopeless prognosis.

SUMMARY

Benign stricture of the oesophagus of unknown origin occurs rather frequently. This report is based on 40 cases.

In more than half of the cases, the stricture is in the lower third of the oesophagus and is single, short, and not particularly dense.

The chief symptom is dysphagia, but pain and regurgitation of blood may be present.

The history and results of examination may suggest malignant disease of the oesophagus, and absolute diagnosis may be difficult.

Roentgenoscopic examination may give negative results or may suggest other lesions than benign stricture.

Dilatation for both malignant and benign stricture of the oesophagus is advocated.

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FURTHER OBSERVATION ON THE TRANSPLANTATION OF THE
EPIPHYSEAL CARTILAGE PLATES. L. HAAS, M. D., SAN FRANCISCO, CALIFORNIA
From the Surgical Laboratory of Stanford Medical School

FROM a series of experiments on the transplantation of the epiphyseal cartilage plate which were reported in two papers in 1915 and 1916 I concluded that the epiphyseal cartilage plate either alone or with an adjoining piece of the epiphysis or diaphysis, lost its power to produce length growth. This conclusion was not in agreement with the previous work of Helfferich, Rehn and Wakabayashi, von Tappeiner, Obata, or Heller, who reported from their observation that they had obtained varying degrees of length growth, especially after reimplantation of the epiphyseal cartilage plate.

Heller, in a subsequent article published in 1917, reported a further series of about 120 experiments in which he transplanted a very thin piece of the epiphyseal cartilage plate, being very careful, checking with magnifying glass to take as little as possible of the adjoining osseous tissue. In one set of experiments he merely reimplanted the cartilage in its normal position after excision from the lower end of the ulna. A wire marker was placed in the diaphysis to determine in which direction growth took place. He found in the reimplantations that there was practically normal growth of the extremity operated upon. In a second set of experiments, the epiphyseal plate was excised and then reversed before reimplanting, so that the side that normally faced the diaphysis was next to the epiphysis. He found that there was an abnormal increase in growth on the epiphyseal side so that the epiphysis was much longer than normal, but in general there was a retardation of growth. In homo transplantation between non related rabbits there was some increase in growth but in general there was a marked retardation. In another group of experiments, he reimplanted the boiled epiphyseal plate and in 2 cases got as much as 1.0 centimeter increase of

length. He concluded from these results that autoplasmic reimplantation of the epiphyseal plate was successful and offered a good chance for favorable application in man.

In 1929, Straub reported a clinical result under the title of "Anatomical Survival Growth and Physiological Function of an Epiphyseal Bone Transplant."

The patient, a boy of 4½ years, had an acute osteomyelitis of the tibia during which practically the entire lower half of the tibia including the epiphysis sequestered. Two years later a piece of bone 13 centimeters long was removed from the anterior part of the internal malleolus of the normal tibia including the epiphyseal cartilage plate. This section of the bone was implanted into the defect in the lower end of the opposite tibia which was destroyed by the osteomyelitis. The upper end of the graft was fixed to the tibia by a silver wire. This boy was followed for 16 years and at the age of 20 years there was excellent function of the leg with 5 centimeters in shortening as compared to 4.5 centimeters in 1914.

Straub concluded that the transplantation of the piece of bone was successful in so far as the survival of growth and function of the epiphysis was concerned. One cannot help being impressed with the almost normal restoration of the form of the lower end of the tibia, but careful study shows that there has not been any appreciable length growth in the transplanted segment of bone. The silver wire which was placed about the transplant at the time of the operation is the same distance from the lower end of the tibia after the elapse of 16 years as it was at the time of insertion. Remembering that the greatest growth takes place normally at the upper tibial epiphysis, it is possible that additional compensatory growth accounts in part for the almost equal growth during the latter years on the two sides.

A few months later an article appeared by Fohl in which he reported the results of his experimental transplantation of the epiphyseal cartilage plate with a piece of the

diaphysis as giving almost normal growth. In two experiments in this same series there was a very marked shortening and three complete failures but he does not offer any explanation for the discrepancies. In another series he transplanted the epiphyseal cartilage plate with the entire epiphysis. In 2 experiments there was full bone growth, in 3 cases there was moderate shortening—two without hewing of foot and one with hewing of foot. In one case there was full loss of growth and marked hending of foot. The tables he presents are not convincing and there are several mathematical errors. In one experiment he transplanted the epiphyseal cartilage plate in an ape and got normal growth. Fohl concluded from his experiment that the substitution of a lost epiphyseal cartilage plate by a transplanted cartilage plate, plus a piece of the diaphysis, has a practical clinical application.

Following the publication of these articles of Straub and Fohl renewed interest was excited in this interesting subject. Feeling that my original findings were possibly incorrect I thought it advisable to repeat Fohl's experiment also those of Heller. If the findings of Fohl and Heller are correct then one is justified in attempting to carry out such a procedure in man with expectations of obtaining successful results. On the contrary, if they are wrong then one should not attempt to transplant the epiphyseal cartilage plate and submit the patient to a needless operation.

In our endeavor to present further evidence for or against the transplantation of the epiphyseal cartilage plate, the following group of experiments was performed upon young, growing rabbits.

1 Reimplantation of the epiphyseal cartilage plate with a very thin layer of adjoining osseous tissue

2 Reimplantation of the reversed epiphyseal cartilage plate

3 Reimplantation of the entire epiphysis and epiphyseal plate

4 Reimplantation of the epiphysis with the varying lengths of the diaphysis

5 Reimplantation of the epiphyseal plate with a portion of the epiphysis and diaphysis

6 Reimplantation of the epiphysis and piece of diaphysis with epiphyseal cartilage plate destroyed

7 Check experiments in which the epiphyseal cartilage plate of both radius and ulna was destroyed

1 *Reimplantation of the epiphyseal cartilage plate* Under ether anaesthesia an incision was made on the dorsum of forefoot near the lower end of the ulna. The epiphyseal cartilage plate of the ulna was exposed. The epiphyseal plate was then excised with a very thin layer of adjoining osseous tissue, a sharp scalpel being used to make the cuts through the periosteum and osseous tissue. After the plate was removed it was reinserted and held in place by suturing the overlying tissue. In order to determine the exact amount of growth at either end, one or two silver shots were placed in the cortex of the diaphysis. After completion of the operation a roentgenogram was made so that at a later date it could be used for determining the amount of growth. At the end of the desired experimental period the animal was sacrificed in the gas chamber. There were 5 experiments in this series (Fig 1). The findings are given in Table I.

TABLE I—REIMPLANTATION OF THE EPIPHYSEAL CARTILAGE PLATE

| No of experiment | Duration of experiment days | Growth of bone operated upon cm | Growth of normal bone cm | Growth on epiphyseal side of marker in bone operated upon cm |
|------------------|-----------------------------|---------------------------------|--------------------------|--------------------------------------------------------------|
| 5 | 28 | 0.3 | 0.6 | 0 |
| 22 | 141 | 2.1 | 3.2 | 1.7* |
| 6 | 168 | 0.5 | 2.6 | 0 |
| 7 | 168 | 0.4 | 2.8 | 0 |
| 1 | 211 | 0.4 | 1.3 | 0.1 |

*Part of plate not removed

In only one experiment, No 22, was there over 0.5 centimeter of growth while the normal growth was five times that amount. In experiment No 22 there was a definite growth on the epiphyseal side of the marker. In the description of the operation it was stated that the cut passed diagonally through the plate and some of the cartilage was not excised. In view of the fact that there was no growth in the 4 other experiments it is

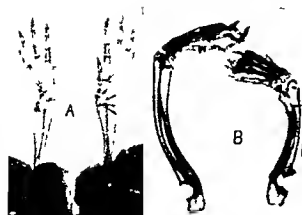


Fig 1 Experiment 7 Reimplantation of the epiphyseal cartilage plate At the end of 168 days the ulna operated upon had increased but 0.4 centimeters while the normal growth was 2.8 centimeters Compare the right leg operated upon with the normal left leg A At time of operation both legs of equal length B Notice marked shortening of the leg operated upon with the markers in the bones

more than likely that the growth in experiment 22 was due in part to epiphyseal cartilage that remained behind

It is difficult to explain the wide discrepancies between Heller's findings and those of present experiments In a similar set, Heller found almost complete growth after the reimplantation of the cartilage plate The difference in the results may be due to a variation in the method of removal of the epiphyseal cartilage If Heller did not remove all of the plate, the remaining cartilage cells could proliferate with resulting increase in length of bone Heller obtained growth after boiling the plate so it is more than likely that he did not remove the entire plate One should keep in mind the fact that the cartilage plate is not a perfect cylinder but its borders are curved and irregular In a straight, transverse cut close to the margins of the plate some cartilage cells may not be removed On the other hand, it may be claimed that in my experiment too much osseous tissue was removed with the plate and the adhering osseous tissue prevented the access of nourishing tissue fluids of the transplanted cartilage which were necessary for its proliferation In removing the plate extreme care was taken so that a very thin layer of osseous tissue was removed

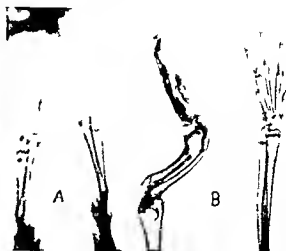


Fig 2 Experiment 18 Reimplantation of the reversed epiphyseal cartilage plate At the end of 147 days the ulna operated upon had increased 0.5 centimeters while the normal bone grew 3.3 centimeters Compare the position of the shots at time of operation to A with those in B at the termination of experiment There has been no growth at the distal epiphyseal plate A Notice equal length of both legs at operation B Notice marked shortening of leg operated upon at end of experiment

Reversing the reimplanted epiphyseal cartilage plate An incision was made over the dorsal surface of the lower end of the ulnar bone and dissection was carried down to the epiphyseal cartilage plate The cartilage plate, with a very thin section of osseous tissue, was then excised The plate was reversed so that the side toward the epiphysis faced toward the diaphysis and was then reimplanted A silver marker was placed in the diaphysis The overlying tissues were brought together, an adhesive plaster dressing was applied to the foot, and the animal was allowed to go about after recovery from the anesthetic At the completion of the experimental time the animal was sacrificed (Fig 2) The results are shown in Table II

SUMMARY

In only one experiment was there any growth In this experiment the anterior part of the plate was not removed, which could account for some of the growth, although not the entire amount It is impossible to explain why there is absolutely no growth in any of the others and an increase in length in this experiment Heller found uniformly growth in bones

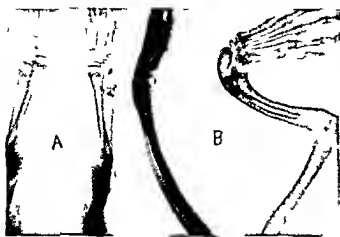


Fig 3 Experiment 27 Reimplantation of the entire epiphyseal end of the bone including the epiphyseal cartilage plate Growth of bone operated upon at the end of 120 days, 0.6 centimeters Growth of normal bone, 3.2 centimeters No growth distal to the shots A, At operation B, At end of 120 days

in which the plate was reversed In the series reported here in which the entire plate was removed no growth took place It is possible that Heller did not transplant the entire plate with the cartilage columns That such may be the case is supported by his own experiments in which he obtained an appreciable growth even after he had destroyed the cartilage plate by boiling before reimplanting

Reimplantation of the entire epiphysis including the epiphyseal cartilage plate The distal end of the ulnar bone was exposed by an incision on the dorsal surface of the foot A cross cut was then made through the metaphysis and the distal end of the bone was removed, after which it was reimplanted in its original position A silver marker was placed in the diaphysis The wound was

TABLE II—RESULTS OF REVERSING THE EPIPHYSEAL CARTILAGE PLATE

| No of experiment | Duration of experiment days | Growth of operated bone cm | Growth of normal bone cm | Growth toward epiphyseal end from marker cm |
|------------------|-----------------------------|----------------------------|--------------------------|---------------------------------------------|
| 12 | 8 | 0 | 0 | 0 |
| 11 | 22 | 0 | 0 | 0 |
| 13 | 140 | 1 0 | 2 0 | 4* |
| 17 | 147 | 0 8 | 3 7 | 0 |
| 18 | 147 | 0 5 | 3 3 | 0 |
| 16 | 149 | 2 7 | 3 8 | 2 1† |

*Non union with gap between fragments

†Anterior portion of plate not removed

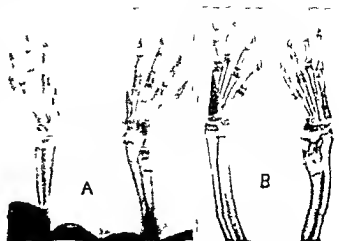


Fig 4 Experiment 8 Reimplantation of the entire epiphysis with a piece of the diaphysis 158 days Growth of bone operated upon, 2 centimeters Growth of normal bone, 2.1 centimeters The epiphyseal cartilage plate of the radius was destroyed also in this experiment Compare the bones at time of operation in A with those at the end of 158 days in B

closed in layers, an adhesive dressing was applied, and, after recovery from the anæsthetic, the animal was allowed its freedom (Fig 3)

There was absolutely no growth in the reimplanted bone in either one of the two experiments This is in direct opposition to the results obtained by Fohl in his reported experiments I can offer no explanation except that it is possible that Fohl's incision passed distal to the cartilage columns, which, not being disturbed very much, functioned in a normal manner

Reimplanting of the entire epiphysis with an adjoining piece of the diaphysis Through a dorsal incision in the lower end of the foot the distal portion of the ulna was exposed A cut was made several centimeters proximal to the epiphyseal cartilage plate, after which the entire distal end of the bone was removed and then reimplanted in its normal position The wound was closed in layers, an adhesive

TABLE III—RESULTS OF REIMPLANTING THE ENTIRE EPIPHYSEAL END OF BONE INCLUDING THE EPIPHYSEAL PLATE

| No of experiment | Duration of experiment days | Growth of operated bone cm | Growth of normal bone cm. | Growth distal to marker in operated bone cm |
|------------------|-----------------------------|----------------------------|---------------------------|---------------------------------------------|
| 21 | 120 | 0 6 | 3 2 | 0 0 |
| 4 | 190 | 0 5 | 1 3 | 0 0 |

found (1) a moderately equally contracted pelvis, (2) a moderately flattened one, or (3) a pelvis within the lower limits of normal. Therefore, in considering the usual pelvic contractions found in cases of disproportion, it is helpful, by means of the accompanying drawing (Fig. 1), to visualize them in relation to the normal superior strait. *A* in this figure represents the moderately equally contracted pelvis present in persons of small stature in most races, and the most frequent type of contracted pelvis in the black race. In evaluating a pelvis of this type, both anteroposterior and transverse diameters appear to be of equal importance. Transverse room is most essential if consistency with the size of the fetus is to be preserved. This type of pelvis is very often associated with rachitic changes, and evidences of the lesions should be sought for, especially in the contour of the anterior surface of the sacrum. Here direct vaginal palpation and roentgenologic examination are of great value. *C* in Figure 1 represents a combination of the generally contracted and flat pelvis. This is often the result of the superimposition of rachitic changes in childhood upon the pelvis of an individual of small stature.

In considering disproportion in association with these abnormal pelvic changes, we should bear in mind the premise that the average fetus, of 3,000 to 3,500 grams, 48 to 51 centimeters in length, with an occipito-frontal diameter 11 to 12 centimeters and biparietal diameter 9 to 9.5 centimeters is for practical purposes always obstetrically compatible with the normal sized pelvis.

In the investigation of the individual case, there are certain points other than the maternal pelvic and fetal cephalic relationships which often furnish important information. The stature and gait of the individual may be studied with profit. The familial physical characteristics of both husband and wife may be important. A husband or a wife of small stature who comes from a family in which large stature is a dominant factor may transmit this latter characteristic to the offspring. In this country, where intermarriage of different racial stocks is common, one often surmises that the principal etiological factor in certain

cases of disproportion may rest largely in the field of genetics.

The age at which the patient walked may give us a clue to rachitic changes in the pelvis. In the general physical examination, not only should outspoken curvatures of the spine be noted, but it should be remembered that even slight lumbar lordosis may be associated with anteroposterior shortening of the superior strait. The conformation of Michaelis' rhomboid is important. Flattening of this figure from above downward or from side to side is usually definitely associated with pelvic contraction. In the multiparous patient, much important information may be gained from the character of the earlier labors. However, such information must be carefully evaluated. The previous labors may not have been at term, or labor may have terminated without difficulty, because of the subnormal weight of the full term fetus.

EXTERNAL AND INTERNAL PELVIMETRY

When we consider the information that is essential to determine the pelvic and fetal relationships, it becomes apparent at once that external pelvimetry is of value only as a guidepost to the true size of the maternal pelvis. It often fails in this function, so that at present we regard these external measurements only as adjuncts to other and better methods of investigation. The usual external pelvic measurements taken are the interspinous, intercrural, and external conjugate diameters. The importance of the first two has been overestimated. The relationship of the one to the other has been emphasized as of diagnostic significance in the presence of a rachitic pelvis, but it is certain that a rachitic pelvis may present the normal relationship of these two diameters. Furthermore, the length of the intercrural diameter cannot be taken as any indication as to the available transverse room at the superior strait.

It is true the shortening of these measurements and that of the external conjugate are usually present in generally contracted pelvises, but it is equally true that a perfectly normal sized pelvic canal may exist in certain short statured, "light boned" individuals whose external pelvic measurements are notably

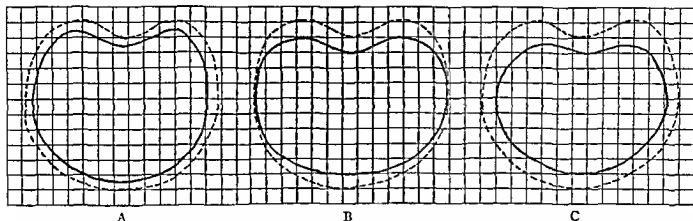


Fig 1 Showing outline of superior strait in normal pelvis, indicated by interrupted line, and the most usual types of contracted pelvis, indicated by the black line. The normal pelvis measures, in the anteroposterior diameter, 10 centimeters, transverse diameter, 12.5. In A the generally contracted pelvis measures, anteroposterior

diameter, 9 centimeters, transverse diameter, 10.75 to 11.25. In B, the simple flat pelvis, the anteroposterior diameter is 8 to 8.5, the transverse diameter is 12.5. In C, the general contracted flat pelvis, the anteroposterior diameter is 8 to 8.5, the transverse diameter is 10.75 to 11.25.

shortened. An example of this is shown in Figure 2, which is a pelvigram of a small white primipara, aged 23 years. The external measurements were interspinal 22.0, intercrural 24.75, external conjugate 16.75. At the end of a 12½ hour labor, an easy forceps extraction of a 3,256 gram baby was performed. The roentgenogram shows a normal pelvic inlet: anteroposterior diameter, 11.25, transverse diameter, 12.5 centimeters.

Most men of experience will agree that the information gained from determining the length of the external conjugate diameter is not as important as was once supposed. In the first place, in the absence of a definite posterior bony landmark, the measurements of two observers may not agree within a centimeter of one another. Secondly, while marked shortening of this diameter is usually indicative of shortening of the anteroposterior diameter of the inlet, moderate degrees of such shortening of the external conjugate are difficult to evaluate. However, I feel that these external measurements should still be used in our routine examination, but that they should be thought of as guideposts only, and not regarded as criteria of the true condition at the superior strait.

The determination of the diagonal conjugate per vaginam, when it can be made, is an important and useful measure. I qualify this statement, since in certain individuals the sacral promontory cannot be reached be-

cause of the height and thickness of the symphysis pubis. In many nulliparous women, because of the rigidity and sensitiveness of the soft parts, the method cannot be used without an anæsthetic. For an examiner to state that his inability to reach the promontory by palpation is *prima facie* proof of an adequate anteroposterior diameter of the superior strait is, of course, ridiculous. Furthermore, the transverse diameter of this plane cannot be even approximated by this method. Nevertheless, a reasonable effort should be made to measure the diagonal conjugate, always remembering that there may be an error of at least 0.5 centimeter in calculating the true conjugate. With regard to determining the pelvic inclination, I agree with Williams (15), who states: "Except when markedly abnormal, the pelvic inclination possesses no practical obstetrical significance, and is of value only in the study of atypical pelvis and in anthropology."

OUTLET PELVIMETRY

In considering pelvimetry of the inferior strait, it may be said that serious disproportion seldom results from outlet contraction unassociated with contraction at the inlet. The importance of measuring the outlet, however, should not be minimized. The funnel pelvis and its relation to perineal laceration and the arrest of labor must be recognized. Fortunately, the landmarks used



Fig. 3 Pelvigram of primipara with small external measurements. The anteroposterior diameter measures 11.25 centimeters the transverse 12.5 centimeters



Fig. 4 Roentgenogram of 'small round' pelvis. The anteroposterior diameter measures 9.75 the transverse 10.5

for measuring the outlet are readily recognized, and outlet pelvimetry is quite satisfactory for determining the essential diameters of that plane. The instrument which we have found of value is the outlet pelvimeter, which I described in 1915 (10)

SUMMARY OF EXTERNAL PELVIMETRY

In general then the procedures noted are usually employed for determining the size of the maternal pelvis. With regard to those methods pertaining to the superior strait, I think it must be concluded that for the most part they are not only inadequate but often misleading. It would appear that if we are to gain more accurate knowledge of this important pelvic plane other methods must be employed and it seems beyond doubt that such methods must have a roentgenographic basis. This idea has become greatly rein-

forced in my mind since surveying the results with roentgen pelvimetry in this clinic—an experience now extending over 8 years.

By means of the roentgenologic methods that we are now employing we are able to perform two important maneuvers: first, to measure accurately both the anteroposterior and transverse diameters of the superior strait, and second, by means of lateral pelvigrams, to outline the relationship of the promontory and anterior surface of the sacrum to the posterior surface of the symphysis pubis. This latter procedure is particularly useful in a patient in whom a rickety pelvis is suspected. Furthermore, in patients at term it gives an excellent idea of the relationship of the presenting part to the pelvic brim.

ROENTGEN PELVIMETRY

I do not propose in this communication to go into the exact details of our technique for roentgen pelvimetry. I would refer those interested to my two latest publications (8, 11) on the subject. I will, however, outline briefly the methods. In pelvimetry of the superior strait, the patient is placed in the semi-recumbent position on the table, with the tube 30 to 36 inches above the plate. The superior strait is made as nearly horizontal as is consistent with the comfort of the patient. The level of the superior strait is established



Fig. 5 Perforated lead sheet. Perforations exactly 1 centimeter apart



Figs 5 and 6 Roentgenograms showing fetal head *in utero* at term. Occipitofrontal diameter readily measured and outline of cranium easily demonstrated

by means of calipers. The distances between the top of the symphysis and the top of the table, and between the depression beneath the fourth lumbar spine and the top of the table are then measured. The tube is centered as nearly as possible over the center of the superior strait. In general, this point is 5 centimeters posterior to the upper border of the symphysis. A suitable exposure is made and the patient is removed from the table—the tube and exposed plate *remaining in position*. A lead sheet (Fig 3) with perforations exactly 1 centimeter apart is now introduced in the same plane as that previously occupied by the superior strait, and a flash exposure made on the *same plate*. Development of the plate reveals the outline of the superior strait and the exposed dots. The space between each two dots equals a distance of 1 centimeter in the plane of the superior strait. Calculations are made directly on the film by counting the dots in the diameter to be measured (Fig 4).

In making the lateral pelvigrams, the patient is placed laterally on the table and the tube centered over a point midway between the upper border of the symphysis pubis and the depression beneath the fourth lumbar spine. The centimeter perforated sheet may or may not be used. Generally, we do not employ it in connection with these

lateral roentgenograms, since we prefer to measure the anteroposterior diameter by the previous method, which also makes available knowledge regarding the transverse diameter.

Of the two procedures outlined, roentgen pelvimetry of the superior strait is more frequently used. The lateral technique is employed only when a rachitic pelvis is suspected, or in certain cases in which there is failure of engagement in the first stage of labor. The importance of accurate mensuration of the transverse diameter of the superior strait is apparent when we consider the more usual types of contractions found in this plane. It is obvious that when shortening of the anteroposterior diameter occurs, compensation must be found in the transverse diameter, if the obstetrical compatibility of the fetus and pelvis is to be maintained. It would appear, therefore, that the length of this line shares in importance with that of the anteroposterior diameter. In a recent paper, I have attempted to emphasize this point, as determined by our roentgen method (12).

FETAL CEPHALOMETRY

The importance of fetal cephalometry is at once apparent in considering the problem of disproportion. While the methods usually employed in determining the maturity of the fetus and the size of the fetal head give us an



Fig 7 Lateral roentgenogram at term. Principal points outlined to show relationship of fetal head to promontory and symphysis. No disproportion.

approximate idea of these important data, the roentgen technique promises to be of as great value in this connection as in pelvimetry.

At the end of the thirty-sixth week of a normal pregnancy, we expect the fetal head to be engaged in the pelvic brim. Lack of engagement generally depends upon one of three conditions: (1) A somewhat distended uterus containing a small fetus which does not require the additional pelvic space; (2) A relaxation of the abdominal walls in a multiparous patient; (3) Disproportion between the fetal head and the superior strait. Therefore, if proper treatment is to be afforded, those cases in which engagement does not occur during the last month of pregnancy require frequent observation and supervision.

One of the principal signs of probable disproportion seen in primiparous women is the abnormal projection of the abdominal wall as term is approached. In multiparous women, owing to the abdominal relaxation which is usually present, this sign is not of the same significance. However, if present in either group, the underlying cause should be determined. The relation of the head to the pelvis may be tested by the method of Kerr (5). In this procedure, the external hand grips the head, as suggested by Pawlik, and pushes it into the pelvis, while two fingers of the left hand introduced into the vagina determine the relation between the pelvis and the head. The thumb of the "internal" hand may be utilized in palpating along the brim,

in order to estimate the degree of overlapping of the fetal head. This procedure may be employed without anesthesia, but greater accuracy is insured if anesthesia is used.

Mueller's well known procedure consists essentially in having an assistant force the head down into the inlet, while the examining fingers determine the degree of descent into the pelvis. Such methods often give us valuable information, but, on the other hand, no knowledge of the real size of the fetal head or of the extent to which it may be molded. With regard to determining the size of the fetal head through the thickness of the abdomen, the methods of Perret (7) and McDonald (6) may be mentioned, but they have not proved to be valuable for the reason that the thickness of the abdominal wall cannot be accurately determined.

We have been impressed in our investigations (13) by the uniformity with which the unengaged fetal head rests in the lower abdomen, with the occiput directed transversely to the right or to the left. Even when the head is dipping, we find that the deviation of the occiput anteriorly or posteriorly makes but little difference in our measurements. We believe, therefore, that in any patient in whom the position of the brow and occiput can be determined by abdominal palpation, the plane of the occipitofrontal diameter can be established and accurate measurements obtained by roentgenography.

Not only can the occipitofrontal diameter be immediately read from the developed plate, but it is possible also to reconstruct the outline of the fetal cranium in its true proportions (Figs 5 and 6). In subsequent studies, we propose to make use of this fact to determine the effect of labor on molding of the fetal head.

We have found that the length of the biparietal diameter is satisfactorily determined on the basis of its ratio to the length of the known occipitofrontal diameter. In order to establish this ratio, we studied the measurements of 149 fetal heads which had *not been subjected to molding*. In this series, 76 were born by uncomplicated breech extraction and 73 by elective cesarean section. In 80 per cent of these cases in which the length



Fig 8 Pelvic roentgenogram at term Showing possibility of pelvic mensuration even at end of pregnancy Small round pelvis The anteroposterior diameter measures 9.5, the transverse, 10.75

of the occipitofrontal diameter measured between 10.5 and 12.5 centimeters, the length of the biparietal diameter measured from 9 to 10 centimeters. In studying the entire group, we were surprised to find that this ratio was remarkably constant. For instance, in 56 of our cases with an occipitofrontal diameter of 12 centimeters or over, the average length of the biparietal diameter was 10 centimeters. In 85 with an occipitofrontal diameter above 10 centimeters but below 12 centimeters, the average biparietal diameter was 9.0 centimeters.

From these relations, we have constructed the following table

| Given an occipitofrontal diameter of 12.5 subtract 2.5 for biparietal | |
|--------------------------------------------------------------------------|------|
| 12.0 | 2.5 |
| 11.5 | 2.0 |
| 11.0 | 1.75 |
| 10.5 | 1.5 |
| 10.0 | 1.5 |
| 9.0 | 1.5 |

We have checked figures in a number of cases which we have been able to study before and after cesarean section, and have thus far found them to be remarkably accurate.

FETAL MATURITY

Authorities agree that the best index to fetal age is the fetal length, or crown-heel distance—a measurement which it is difficult



Fig 9 Roentgenogram of same case as in Figure 8 for cephalometry in utero Occipitofrontal diameter, 10.5, biparietal diameter, 9.0

to determine in certain patients with thick abdominal walls, or those with hydramnios. The determination of the length of the occipitofrontal diameter may furnish valuable data bearing on this question, for we have found that this length bears a definite relationship to the length of the fetus. From our data, it would appear that an intra-uterine occipitofrontal diameter of 11.5 or over signifies a safely mature fetus, while a measurement of 11.0 indicates that the fetus is but slightly, if at all, premature. A diameter below 10.5 centimeters in length would appear to indicate unquestionably that the fetus is premature (14).

LATERAL PELVICGRAMS

We have already spoken of obtaining the lateral pelvic roentgenogram. This procedure is extremely useful in cases of suspected disproportion, because the direct relationship of the fetal head to the anteroposterior diameter of the inlet may be determined (Fig 7). It is also of value in determining the exact descent of the fetal head in those patients who are undergoing a test of labor. I have previously pointed out (9) the value of lateral pelvigrams in the diagnosis of rickets pelvis.

In a discussion of disproportion, two other important factors must be considered. These

are the force of the uterine contractions and the ability of the fetal head to become molded. With respect to the latter, we cannot say at this time just how adaptable the fetal head may become, but we know that excessive molding causes excessive cranial stress, resulting in overstretching and tearing of the tentorium cerebelli and falx cerebri. In this connection, Ehrenfest (2) and Holland (4) have shown that the long delay in expulsion of the head resulting from disproportion leads to marked hyperemia of certain parts of the brain, with exaggerated arterization of other parts. Therefore, where the outcome is questionable because of the existence of disproportion, we should not overvalue the ability of the head to become molded.

SUMMARY

In the foregoing the methods used in this clinic for determining disproportion between the fetus and the maternal pelvis are summarized. These methods are not all used routinely in the examination of pregnant women, nor are they all used in all cases of suspected disproportion. The methods are adapted to the individual case. The interpretation of the findings is judged in the light of clinical experience. Our results show one thing to be certain—in doubtful cases much of the guesswork of former years is eliminated. The methods may be used at all stages of pregnancy, and even in the first stage of labor (Figs 8 and 9). The apparatus and technique are extremely simple. It is the writer's opinion that the time has arrived when to treat doubtful cases of disproportion

without proper roentgenological examination is as culpable as to treat fractures without the aid of the same diagnostic means. If these methods prove as valuable as they now seem to be, it is likely that in the future, in addition to the methods now in common use, roentgen mensuration of the pelvis will be carried out in all primiparous patients.

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CLINICAL SURGERY

FROM THE SURGICAL DEPARTMENT OF THE UNIVERSITY OF NEBRASKA I

TECHNIQUE OF SUBTOTAL THYROIDECTOMY

ALFRED BROWN M.D. F.A.C.S., OMAHA, NEBRASKA

THE results to be aimed at in subtotal thyroidectomy are First, to furnish an ordeal which is neither painful nor nerve racking to the patient, second, an operation performed under such conditions that when a toxic state of the thyroid is present postoperative thyroid storm will not occur, third, the removal of sufficient gland substance to avoid recurrence of hyperthyroidism and not enough to cause hypothyroidism, and fourth (and in the opinion of the patient by no means the least) a good cosmetic result with minimal scar. The results to be avoided, which may be grouped under the most frequent complications, are first, secondary hæmorrhage, second, changes in the voice following operation, and third, postoperative tetany due to destruction or removal of the parathyroid bodies.

The pre operative preparation of the patient is best carried on in conjunction with an internist in order that the proper time for operation in serious cases may be determined by consultation and one individual does not have to make the decision. In this way undue enthusiasm on the part of the surgeon and undue conservatism on the part of the internist may be curbed and a conclusion reached which will be of more benefit to the patient.

As an immediate pre operative preparation the patient is given 30 grains of sodium bromide the night before the operation. An hour and a half before operation morphine sulphate, $\frac{1}{4}$ grain, and scopolamine, $\frac{1}{150}$ grain, are given hypodermically and then Fischer's solution, 6 ounces, at body temperature, containing glucose 5 per cent and sodium bromide, 60 grains, are injected slowly high in the rectum by gravity through a small catheter. Three-quarters of an hour before operation another dose of the same amount of morphine and scopolamine are given hypodermically and by the time for removal to the operating room the patient is usually asleep and the journey is accomplished without disturbance of this sleep.

In another communication I have given the reasons why it is my opinion that cervical para-

vertebral anaesthesia prevents cardiac storm during and after operation, and this type of anaesthesia is now employed in all my personal cases. It is interesting to note that though the patient may be disturbed somewhat during the injection of one side of the neck, by the time the upper injections are made on the opposite side the patient once more passes into a quiet dreamy condition or even one of actual sleep.

Placing the patient in position with head thrown back, preparation of the skin with picric acid 5 per cent in 80 per cent alcohol, draping the field and changing of gloves and gown by the operator occupies sufficient time for the anaesthetic to take effect and operation can be begun immediately.

A curved collar incision having a slight convexity upward and having its center about 1 inch above the episternal notch is made. When the neck returns to its normal position, this will be found to lie in such a position that in women it will be covered by a string of small beads. It is important that the upward curve of the incision at either end where it overlaps the edge of the sternomastoid muscle by about an inch be very slight as otherwise the scar at this point will be visible. The incision is carried downward through the platysma throughout its entire length until the vessels passing up and down over the pre tracheal muscles and the muscles themselves, including the inner portions of the sternomastoids are uncovered. It is important that any sizeable bleeding points in the subcutaneous tissue be clamped and ligated at this time. If this is not done now, it may be neglected later and bleeding from the small vessels, particularly those over the episternal notch and in the angles of the wound may give rise to secondary hæmorrhage which, though not necessarily dangerous, nevertheless results in considerable oozing which is alarming to the patient.

The upper flap is dissected upward as far as the thyroid cartilage and the underlying muscles are well exposed. The lower flap is also dissected free

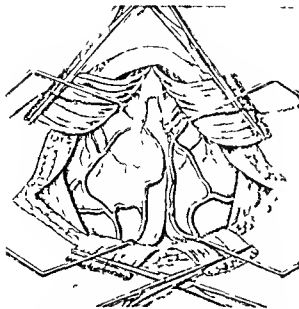


Fig 1 Skin flaps turned back, pretracheal muscles clamped, divided and retracted by spring retractors. Compress covering flaps is not shown

from the underlying structures for about half an inch in order to give it a small amount of play and allow suturing to be done later with more ease and more accurate apposition of the platysma muscles and skin. The anterior jugular veins are now clearly seen lying on the surface of the pretracheal muscles and act as guides between which a longitudinal incision is made to separate these muscles in the median line from the level of the notch of the thyroid cartilage above to the episternal notch below. The edge of the sternohyoid muscle is lifted up and the sternothyroid is seen beneath it. It is freed in turn by dividing the fascia along its inner margin by sharp dissection and then sweeping the finger beneath it following the line of cleavage between it and the thyroid gland until the muscle is freed from the gland from the upper to the lower pole. This is done on each side and the care with which it is done makes for ease in delivery of the gland, for it is surprising how a few fibers of this muscle covering the thyroid will hinder the subsequent steps of the procedure. With the finger passed beneath the ribbon muscles holding them forward, two clamps are placed transversely on either side and the muscles are divided between them. Warm moist compresses are now placed over the skin flaps and hooked spring forceps are placed in the muscles to give a good exposure of the gland (Fig 1).

The next step in the procedure is of extreme importance and is one to which little attention has

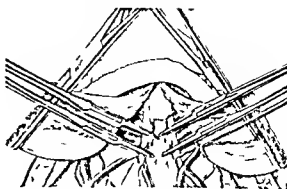


Fig 2 Clamps have been placed on the suspensory ligament

been directed. Many years ago Kocher noted the fact that the superior laryngeal nerve might be injured during ligation of the upper pole of the thyroid gland and more recently Dilworth, New, Mullin, Berlin and Lahey, and Nordland have shown that the superior or external laryngeal nerves, contrary to the usual teaching of the text books, supply not only the cricothyroid muscles with motor fibers but also furnish motor innervation to the interarytenoid muscle. If, therefore, during ligation of the upper pole of a high lying thyroid, the superior laryngeal nerve be injured it is possible that voice changes may result through loss of function of the cricothyroid or interarytenoid muscles. The external branch of the superior laryngeal nerve lies on the outer surface of the thyroid cartilage and the cricothyroid muscle covered by, and closely in contact with, the inner surface of the superior pole of the thyroid. When ligating the superior pole it may best be avoided as follows. The upper margin of the thyroid isthmus and the inner margins of the upper poles are held in close contact with the cricoid cartilage and cricothyroid muscles by a band of fascia, the suspensory ligament of the thyroid, which passes downward from the thyrohyoid membrane and thyroid cartilage, and represents the remnants of the embryonal stalk of the thyroid gland. In some cases it contains the so called middle lobe of the thyroid. It also contains internal branches of the superior thyroid artery which anastomose in front of the cricoid cartilage, and this anastomosis sends branches downward to the isthmus and inner portions of the lateral lobes (Fig 1). The first step in thyroidectomy, after exposure of the gland, is the division of the suspensory ligament between clamps and ligation of the stumps (Fig 2). If a middle lobe is present it is also clamped and ligated with the ligament. Thus there is left a small portion of normal thyroid

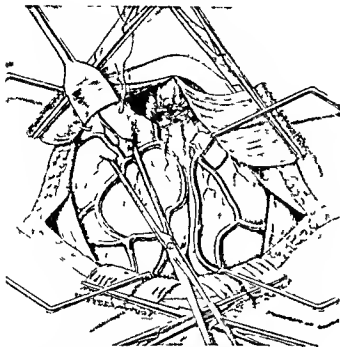


Fig 3 The suspensory ligament has been divided and ligated. The upper pole is grasped with a forceps and drawn forward and outward away from the larynx while the upper pole is ligated

which practically never becomes diseased. The isthmus and upper poles are now free from the larynx and can be drawn forward and outward and the upper poles ligated with No. 1 chromic catgut with no danger to the superior laryngeal nerve (Fig 3). The ligature is passed through the tissue of the thyroid and includes the superior thyroid vessels, thus constituting a mass ligation of the upper poles. I have practised this for many years and it has also been recommended by Gustav Schwyzer who believes that the healthiest tissue is found in the upper pole of the gland and that ligation *en masse* preserves it. It is, however, well to examine the upper poles carefully and if any small adenomata are present the ligature should be placed above them so they may be removed with the remainder of the thyroid mass.

The upper poles being ligated, the fingers are passed along the lateral margins of the gland and the middle veins are clamped and divided, as recommended by Hertzler. The finger then sweeps downward around the lower lobe which is delivered from its bed and brought up into the wound (Fig 4). The inferior thyroid veins are then clamped well toward the posterior surface of the gland.

This procedure having been carried out on both sides the line of division of the thyroid is now well mapped out by the ligature above and the clamps on the veins below. With the finger behind the

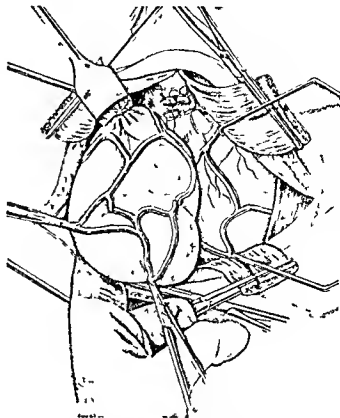


Fig 4 The upper pole has been ligated and the lower pole is being elevated with the finger

gland, the upper pole is divided and the incision is carried downward in front of the clamps (Fig 5). The vessels are clamped within the gland as they are reached and the finger behind the posterior capsule serves two purposes. The clamping forceps can be prevented from grasping the capsule and endangering the recurrent nerve and parathyroids and the sense of touch tells the operator how much thyroid tissue he is leaving attached to the capsule and only a thin layer of tissue should be left. During this procedure an assistant rolls the gland over toward the midline and as the trachea is approached the incision moves toward an anterior plane in order to leave a triangular piece of thyroid in front and lateral to the recurrent nerve.

During this part of the operation, the patient is aroused and made to speak as each clamp is applied and before any further incision is made in order to make sure the recurrent nerve is not caught in a clamp or pressed upon.

The lower and lateral branches of the inferior thyroid artery are easily caught by clamps but the smaller branches which run in an anteroposterior direction between the inner surface of the lateral lobe and the lateral surface of the trachea are more difficult to catch and if not well clamped before being divided may retract and

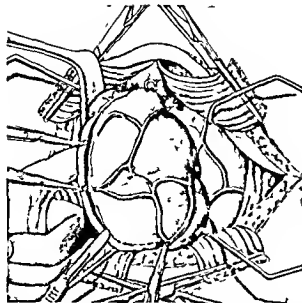


Fig. 5 The line of section of the gland is mapped out and the incision through the capsule is being made

give rise to unpleasant bleeding which may take some time to check and the recurrent nerve may be endangered during the procedure. If the lobe is rolled well over toward the opposite side and the depth of the incision carefully watched these vessels will be found to come into view as the trachea is neared and can be clamped at this time (Fig. 6). While speaking of clamping vessels it is well to remember that the jaws of clamps should always be closed in a direction parallel to the course of the recurrent laryngeal nerve, that is from above downward, and never in a direction at right angles to it. The small vessels being divided the trachea is reached at a point halfway between its posterior and anterior limits and the isthmus is separated from it leaving the layer of fascia covering the trachea intact. When the procedure outlined has been carried out on both sides about five sixths of the entire gland is removed leaving a small piece of gland attached to each upper pole and a thin shell attached to the posterior capsule in the angle between trachea and oesophagus. The vessels are now ligated with No. 1 plain catgut and the clamps are removed, when the stumps fall backward into the depths of the wound. If the clamping and ligating of vessels has been done carefully and not too much thyroid tissue has been included in the clamps and ligatures, a mass suture of the raw surface of the gland to control oozing is unnecessary. If there is no oozing I believe a suture of this type is better omitted for the insertion of a needle between trachea and stump of

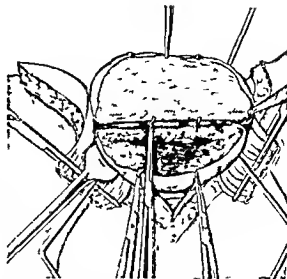


Fig. 6 The small vessels along the inner margin of the lobe are appearing and are clamped as they are encountered

gland may endanger the recurrent laryngeal nerve by either including it in the ligature or snaking and wounding it with the needle, or by traction upon it which dislocates it forward as the inner leaf of the capsule covering the stump is drawn forward and outward to meet the outer leaf when the suture is tightened.

Before the closure of the muscles, the drains are inserted. These are small gauze wicks which are passed between the sternal and clavicular heads of the sternomastoid muscle on either side and emerge near the lateral angles of the wound as suggested by Lahey. They prevent the occurrence of the dimple and adhesion which sometimes follow midline drainage. By the time this stage is reached, the anesthesia of the muscles may have worn off and it is wise to inject 2 or 3 cubic centimeters of 1 per cent novocain solution into the sternomastoid before making the pathway for the drain. This should be made with a pointed hemostat (Kelly type) and never with a sharp instrument because there may be an aberrant vein lying at this point and if divided it can cause very troublesome hemorrhage. When the forceps has passed through the muscle the drain is grasped and drawn through from within outward and its inner portion is laid over the stump of the thyroid. Drains are removed on the third or fourth day.

The patient's head is now raised and the divided edges of the pretracheal muscles are sutured with a lock stitch of No. 1 chromic catgut. As these are inserted, locked loops are passed around the anterior jugular veins above and below the line of

muscle section. When the muscle clamps are removed these vessels do not bleed at once but it is important to remember that they may open up later and cause troublesome hæmorrhage if not securely ligated. The internal edges of the pretracheal muscles are now sutured throughout the whole length of their separation with No. 1 chromic catgut.

Sensation has now returned partially to the skin and its edges should be anesthetized by subcutaneous injection of 1 per cent novocain solution introduced from within outward so the injection will not be felt by the patient. The skin and platysma are now approximated by a "dermal" suture which is introduced by passing it first through the entire thickness of the flaps and next through the skin only, the next passes through full thickness and the next through skin only and so on (Fig. 7). The approximation of both deep and superficial tissues by this method is accurate, insertion of a separate row of absorbable sutures for the platysma is avoided, and the resulting scar is a thin line in which the stitch holes do not show if the suture is removed before the fifth day.

A dressing of vaseline gauze covered by plain gauze is held in place by an adhesive strap which passes behind the neck, where it is covered to prevent sticking, crosses over the dressing in front, and the two ends applied to the chest above the breasts. The patient is then returned to bed where hypodermoclysis of 1000 cubic centimeters of normal saline solution is started immediately.

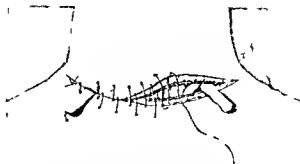


Fig. 7 Showing method of inserting suture in skin and platysma and site of insertion of drains

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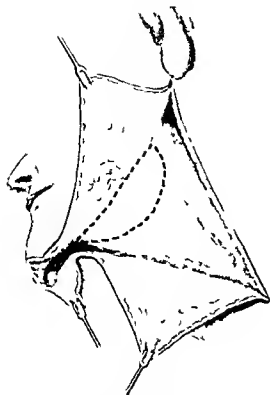


Fig. 2 Skin flaps retracted and semi oval area of bone outlined for temporary dissection

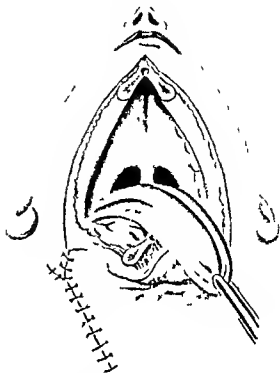


Fig. 3 Tongue pulled through wound Illustrate wide field of operation

cavity and eventually death was caused by heart failure through intoxication.

The second patient died from aspirational pneumonia. In this case also operation was done under chloroform anæsthesia and preliminary ligation of the tongue artery had been done previous to the removal of the growth. On the second day after operation the temperature reached 39.5 degrees pulmonary symptoms developed, and the patient died.

The other patients made uneventful recoveries and left the clinic in a short time looking somewhat improved. In 2 of the cases I used local regional anæsthesia—80 to 90 centimeters of a ½ per cent novocain solution. The anæsthesia was complete. Briefly, the method was as follows. The novocain solution was injected into the nerve endings of the cervical plexus at the dorsal margin of the sternocleidomastoid muscle. The retromolar trigonem, and the alveolar and lingual nerves were blocked through the mouth and the solution was injected along the skin wound at the lateral margin of the mylohyoid muscles and under the mucosa of the bottom of the oral cavity in the region of the mental nerves as

well as into the tissue of the tongue. In the last patient ether anæsthesia was used.

Objections have been raised to the use of the infiltration method with novocain solution in cancerous growths but the use of chloroform has been advocated. I believe that local anæsthesia is the better method and in the future I shall try to perfect the method, avoiding however, the infiltration of the tissues in the immediate vicinity of the cancerous growth. Preliminary ligation of the lingual artery I do not believe is really needed for if the artery is tied off, it may give rise to the sensation of numbness of the stump of the tongue.

In conclusion, I wish to state that my method has been successfully used in the clinic of Professor Rasumowski (at Saritov) on 2 patients. Furthermore, Dr. Bodroff informed me at the last Congress of Russian Surgeons at Moscow that Professor Kolubakin had tried it in 2 of his cases, 1 of which was successful.

The method described has already been used in 9 cases, in 6 of which recovery was uneventful and the patients have fair promise for the near future.

CLINICAL APPLICATIONS OF BLADDER TUMOR PATHOLOGY¹

PAUL W ASCHNER, M D F A C S, NEW YORK

From the Surgical Service of Dr Edwin Beer and the Laboratories of the Mount Sinai Hospital

TUMORS of the urinary bladder present a frequent and a difficult problem to the urologist. This is evidenced by the ever growing series of cases reported from the larger clinics both in this country and abroad. The ultimate object of analyzing groups of these cases is to determine the results of the various forms of therapy employed, whether they be physical and chemical agents, surgery, or combinations of the two. For the individual patient one aims to be guided by the deductions from such analyses in deciding what plan of treatment offers the best chance of cure. When we discuss the modes of therapy at our disposal we understand each other reasonably well. When we attempt, however, to indicate the nature of the disease process from which the patient is suffering, we are sometimes on common ground but frequently we are far apart and seem to be conversing in foreign tongues. The cause of this misunderstanding is due in a measure to the complexity of the underlying pathological problem but in much greater degree to the inaccurate and divergent terminology employed in the classification of the lesions not only by clinicians, but by pathologists as well. That serious confusion exists is apparent, for one observes a frequent discrepancy between the urologist's and the pathologist's interpretation of the individual patient's malady. Thus in some series of cases the former has included in the carcinoma group, patients upon whose removed tumor tissue the pathologist of the same clinic has reported papilloma.

Now this bespeaks a certain lack of confidence on the part of the clinician in his colleague's interpretation of the histology of the tumor. Although many urologists admit, as Geraghty did, their inability to differentiate benign and malignant papillary growths by cystoscopic inspection, they nevertheless choose to dispense with the biopsy, the court of appeal in the case of doubtful tumors elsewhere in the body. They prefer to be guided by a therapeutic test, the mode of response to fulguration—electrodesiccation with the Oudin current, or electrocoagulation with the d'Arsonval current—(6, 7, 8).

A shroud of mystery seems to invest the subject of bladder tumors. The following factors appear responsible for their being regarded as something apart from the neoplasms of the rest of the human

body, not amenable to the usual classifications, nor to the usual modes of diagnosis and treatment.

1 In the earlier days of open suprapubic operation, the removal of a seemingly innocent papillary tumor, histologically benign, was frequently followed by the subsequent development of similar tumors in the bladder and at times even in the drainage tract or postoperative scar. This was regarded as evidence of malignancy, and it was maintained that all papillary bladder tumors were carcinomatous, a view propounded years previously by Rokitsansky and opposed by Virchow.

2 Patients with multiple papillary tumors, frequently small and sessile (papillomatosis), may subsequently have frank carcinoma of the bladder, or may develop metastatic phenomena and run a malignant clinical course (Buerger).

3 Rare cases of papilloma of the bladder have been described, the cells of which show no appreciable variation in type or arrangement from those of the ordinary papilloma. And yet the villi infiltrate the bladder wall beneath the tumor penetrating even into the perivesical fat. Buerger reported one such and designated it as an infiltrating papilloma but correctly classified it with the papillary carcinomata. Geraghty related a somewhat similar case.

4 The introduction and retention of the term malignant papilloma in the literature of the subject has been one of the most potent factors in the misunderstandings which prevail. It appears in the classifications of Geraghty, Young, Stenius, Scholl, Christeller, MacKenzie, Scott and McKay, and others. By this term is usually meant papillary tumors the cells of which are partly or entirely atypical or anaplastic but show no evidence of infiltrating the stroma or base. These tumors correspond to the changed papilloma of Buerger which he rightly included among the papillary carcinomata in the final classification of his material.

5 The next factor is a corollary to the preceding, namely that only such tumors are usually classified as papillary carcinomata which present infiltration of the bladder wall (e.g., Geraghty, Stenius, Christeller, MacKenzie).

6 The most recent addition to the sources of confusion is the classification of bladder tumors without reference to their gross pathology, their situation, extent, or invasive character. The basis

¹A briefer report of this study appeared in the *Journal of the American Medical Association*, 1923, xci: 1697. Slight discrepancies are due to the obtaining of additional follow up data and some minor errors in the statistical tabulations. Presented at a stated meeting of the New York Academy of Medicine, March 6, 1930.

TABLE I A — CLASSIFICATION OF VESICAL NEOPLASMS

- 1 Primary epithelial tumors—
 - A Papillary (fibro-epithelial) tumors
 - Papilloma (benign)
 - Papillary carcinoma (malignant)
 - Non infiltrating
 - Infiltrating
 - B Non papillary (flat) epithelial tumors
 - Adenoma (benign)
 - Solid
 - Cystic
 - Carcinoma (malignant)
- 2 Primary mesoblastic tumors—
 - A Benign
 - B Malignant (sarcoma)
- 3 Embryonal tumors—
- 4 Secondary tumors—
 - A By extension e.g. from prostate cervix rectum
 - B By implantation e.g. from kidney pelvis or ureter
 - C By metastasis

of this system rests primarily on the proportion of undifferentiated (unripe) cells to differentiated (ripe) cells in the given neoplasm. All bladder tumors are looked upon as potentially malignant by those who employ this classification, e.g., Broders and Bumpus. The propensity for invasive growth is regarded as sufficient to consider them so. This would seem a reversion to the views of Rokitsansky.

If one now considers neoplastic processes in other parts of the body it becomes evident that analogous factors are encountered though not with the same frequency which obtains in the field of vesical neoplasms nor is the same interpretation put upon them. (1) Thus the occurrence of multiple warts or condylomata on opposed skin surfaces in such a way as to suggest contact lesions or implants is not considered a sign of malignancy. The epithelial inclusion cysts occurring after puncture wounds of the skin (by hypodermic or suture needles) are not regarded as malignant although they may become so occasionally. (2) The occurrence of multiple neurofibromata in Von Recklinghausen's disease is likewise not so classified although sarcomatous changes may occur rarely in them. Gastric or colonic polyposis may exist for years and is considered benign although carcinoma may develop from one or more of the lesions. (3) Connective tissue growths made up of cells indistinguishable from fibroblasts but not delimited by a capsule and invading the surrounding subcutaneous structures, are called fibrosarcomata because of this invasive property alone. A thyroid tumor may metastasize to bone neither primary nor secondary growth showing histological features of malignancy yet these tumors are classified with malignant neoplasms. The adenoma malignum, or destruens of the uterus picks

TABLE I B — THE COMMON VARIETIES OF VESICAL NEOPLASMS ACCORDING TO THEIR GROSS AND MICROSCOPIC CHARACTERS

- 1 Papilloma (benign)—cell uniformity and typism—
 - 1a Dendunculated Single
 - 1b Multiple
 - 1c Papillomatosis
- 2 Papillary carcinoma—
 - 2a Non infiltrating
 - 2a1 Scattered areas of somewhat atypical cells
 - 2a2 More diffuse and more marked atypism
 - 2b Infiltrating
 - 2b1 Cells of benign type (rare)
 - 2b2 Stromal or stalk invasion
 - 2b3 Cells anaplastic (atypical)
 - 2b4 Submucosal base invasion
 - 2b5 Muscularis and perivesical invasion
- 3 Non papillary (flat) carcinoma—
 - a Fibro (sarcoma)
 - b Melanoly (transitional cell)
 - c Adeno (from von Brunn's glands)
 - d Squamous
 - e Hornifying

in its cells and structure the microscopic marks of malignancy but it is grouped with the adenocarcinomas because of its properties of infiltrating the muscularis and metastasizing. (4) If a tumor of the uterine endometrium presents only the cellular changes of malignancy without evidence of infiltrating the muscularis one does not hesitate to label it adenocarcinoma. The term malignant adenoma would be a misnomer in such a case, something very different being connoted thereby as has just been pointed out. (5) In malignant tumors in general one recognizes that a stage of development exists in which the lesion is superficial yet they are not excluded from the carcinoma on this basis. (6) The invasive character of a tumor has long been relied upon as an indication of its grave nature. Malignancy is not solely recognizable by cellular changes. Invasion and metastasis are also reliable indications, be the cells ever so innocent in appearance.

There is need, therefore, of a classification of vesical neoplasm which will serve the pathologist by its accord with the general principles of tumor pathology and terminology, and will meet the requirements of the clinician because it takes cognizance of gross as well as microscopic criteria. Such is I believe, the following classification based upon the literature, and upon the material of the Mount Sinai Hospital available for study since 1911 (Table I A).

The common varieties of primary vesical tumors (Table I B) are papilloma, papillary carcinoma,



Fig 1 Specimen taken for biopsy from a case of multiple papillomata of the bladder $\times 45$



Fig 2 Part of resected bladder wall bearing sessile type of papilloma Shows multiple stalks of origin and fusion of the villi No invasion of stroma or base $\times 12$

noma, and non papillary carcinoma. This simple yet adequate classification was used by the late Dr F S Mandlebaum in his beautifully illustrated contribution of 1907 (10). In this study of 37 cases he confirmed the belief that papillary carcinoma may be primary, or may develop from a pre-existing benign papilloma. Buerger, of the same laboratories, in a series of 113 cases, made a more detailed report of the histological criteria upon which the diagnosis of "changed papilloma" could be based (3). The changes he found occurred not only in the deeper parts of the growth, but in those portions accessible to cystoscopic re-

moval of tissue for diagnosis. Of 52 cases of carcinoma 13, or 25 per cent, fell into this category and presented various stages of the transformation. Upon the basis of his observations it became more and more customary for the urologist to remove fragments of tumor tissue for microscopic study and to be guided in a considerable measure thereby in meeting the therapeutic problem which each case presented.

TECHNIQUE OF THE BIOPSY

While fragments of tumor tissue may be recovered in washings of the bladder, a much more



Fig 3 Biopsy specimen from a case of "adenopapilloma" $\times 36$



Fig 4 Biopsy Multiple small papillomata Shows edema and inflammation of stroma, cystic degenerative changes in epithelium $\times 45$



Fig 5 Biopsy from a sessile papilloma. Same case as Figure 2. Shows the well defined limiting cell membranes $\times 120$



Fig 6 Biopsy from huge papillary tumor. Showing papilloma architecture but areas of large atypical cells the importance of which was not recognized. Operative specimen papillary carcinoma (type 2a) Case 2 $\times 165$

certain method is their cystoscopic removal by means of the rongeur forceps or Young's cystoscopic rongeur, or the snare. The simplest method is the rongeur forceps applied through the operating cystoscope. If a single tumor is present fragments should be removed from several parts of the mass for the malignant changes may be confined to a limited area. Especially should more solid looking hemorrhagic or necrotic areas be investigated. If several tumors present themselves a biopsy should be performed on as many as

feasible, particularly those which lack the typical fluffy villous character of the benign papilloma. If the mucosa about the base is nodular in appearance this site should be attacked. If the tumor is flat and its central portion necrotic or ulcerated the forceps should be applied to the viable periphery of the neoplasm.

In many instances the operator has sent to the laboratory bits of tissue which adhered to the fulgurating electrode. While information may be derived from such material I have observed that



Fig 7 Biopsy from base of papilloma showing inflamed stalk and remnants of viable investing epithelium. July, 1914. Case 8 $\times 45$



Fig 8 Biopsy specimen of one of the tumors found in the bladder November 1918. Papilloma. Case 8 $\times 45$



Fig 9 Biopsy of recurrent tumor at fundus which did not respond to fulguration. Papillary carcinoma. Case 8



Fig 10 A section of the resected tumor showing stroma and submucosal invasion (type 2c). Case 8. X45

such tissue frequently shows the effects of the coagulating current and is unsuitable for reliable histological study. Patients treated with electrocoagulating currents and then subjected to biopsy may present not only these disadvantages but also secondary inflammatory changes, necrosis, and incrustation which render the task of the pathologist more arduous. I would urge, therefore, that the operator remove the tissue for diagnosis and then apply his electrode to the tumor. This procedure will minimize bleeding and will seal off the traumatized area. Thorough irrigation to remove liberated cells should follow.

In the cases of benign papillomata which respond to endovesical therapy the urologist should remove a specimen from the base of the tumor as soon as this becomes visible, or from the resulting ulcer of the bladder mucosa whence the tumor sprang. It is only in this way that the most treacherous but fortunately rare form of papillary carcinoma may be detected in time. I refer to the infiltrating tumors the cells of which, even if they invade the base, present no anaplasia, and differ in no detectable manner from those of the benign papillomata.

With the increasing use of the endotherm knife



Fig 11 Biopsy of small papilloma appearing in the bladder vault three years after resection of papillary carcinoma. Case 8. X45



Fig 12 Biopsy of pedunculated papillary carcinoma (type 2a). Fulguration, dissemination. Died of infiltrating papillary carcinoma 22 months later. Case 12. X75



Fig. 13 Operative specimen. Area of tumor presenting atypical cells and mitoses. Papillary carcinoma (type 2a). Case 13. $\times 45$.

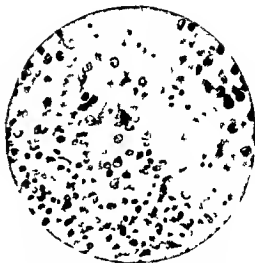


Fig. 14 High power photomicrograph of same specimen as is shown in Figure 13. Case 13. $\times 140$.

and surgical diathermy, the study of resected tumor bearing areas of the bladder wall has also been rendered less satisfactory because of the effects of the current upon the tissues. While this is disconcerting to the pathologist, it is evidence of the rationale of the newer methods employed in attacking the problem of malignancy.

The fixed tissue method of study has been adhered to in this laboratory because we have been unwilling to submit the valuable specimen obtained through the cystoscope to the hazards of frozen section work, because a permanent prepa-

ration is highly desirable as a matter of record and because rapid methods make a report within 24 hours regularly attainable. The single hematoxylin stain is very satisfactory and personally I prefer it to the double hematoxylin-eosin stain. When necrosis or inflammation is present, iron hematoxylin will often bring out nuclear details which are not secured otherwise. The van Gieson stain is of value in determining the question of infiltration of the bladder musculature.

I have reviewed the slides of every tumor submitted to biopsy or operation at the Mount Sinai



Fig. 15 Metastatic carcinoma of the omentum which developed 2 years after operation on the bladder. Case 13. $\times 45$.



Fig. 16 Biopsy of papillary tumor which did not yield to fulguration. August 9, 1917. Papillary carcinoma (type 2a). Case 14. $\times 45$.

Hospital since 1911 and have diagnosed each in accordance with the classification outlined. The clinical information and subsequent course of the patient were obtained from the data made available by the late results recently compiled by Dr Beer and his associates. There were two objectives of the study, first, an evaluation of the biopsy for diagnosis, second, an evaluation of the pathology for prognosis. In several instances my diagnosis differed from the one originally rendered, probably because the criteria for benign papilloma have become progressively more strict, and because I have learned to attach greater importance to slight cell changes which formerly were either overlooked or their significance underestimated.

PAPILLOMA

The ordinary variety of papilloma is a soft, shaggy, villous tumor springing from the bladder mucosa by a well defined pedicle. A delicate connective tissue core continuous with the submucosa of the bladder and containing blood vessels forms the skeleton. Surrounding the core and its delicate branches is an investment of epithelium continuous with the epithelium of the bladder mucosa. The cells are arranged in a radial palisade manner at right angles to the core demarcated from its stroma by a well defined basement membrane (Fig 1). The epithelium may be few or many layers deep. As the tumor grows, adjacent villi fuse. The fusion may go on to produce an almost solid epithelial tumor with little stroma.

A number of stalks growing simultaneously from the bladder wall and fusing as they grow produce a broad based sessile type of growth, the villi of which are short and rounded (Fig 2). Another form of sessile papilloma appears to be derived by proliferation of the cells lining the glands of von Brunn and these may be designated as adenopapillomata (Fig 3). Ulceration, necrosis, and incrustation occur in papillomata rarely, and then usually after treatment.

The cells of the tumor present a high degree of uniformity in size and shape. The nuclei are elongated, elliptical, stain rather uniformly, and may show mitosis in the deeper layers of actively growing tumors. The cytoplasm of the cells is poorly demarcated from that of its neighbor. The surface cells may show hydropic degeneration if the growth is subject to trauma by the sphincter vesicæ. Inflammatory changes in the stroma may be marked as the result of infection (Fig 4). The basement membrane, however, remains intact and tumor cells do not invade the stalk. In the solid sessile tumors there is a tendency for the limiting

cell membranes to be more prominent and for mitoses to be more frequent (Fig 5).

In Table II, I have summarized 90 cases of papillomata diagnosed on biopsy and confirmed by response to high frequency treatment, operative specimen, and late results. New tumors or recurrences occurred in 23 per cent of these patients, but they too were benign and responded to high frequency treatment, and in one case to resection.

CASES ILLUSTRATING DIAGNOSIS, TREATMENT, AND COURSE OF PAPILLOMATA OF THE BLADDER

Mrs A F had a large, sessile papillary tumor. Two biopsies showed typical papilloma. The growth was destroyed after several treatments with monopolar current. Cystoscopic control 4 years later showed no recurrence.

D H had a small, pedunculated papillary tumor. Biopsy examination showed papilloma. Growth was readily destroyed with the high frequency current. In third year a few small mucosal elevations were noted and destroyed. Patient was cystoscopically well 4 years later.

A I had a small papilloma confirmed by biopsy, which was cured by fulguration. Cystoscopy, 10 years later, showed no recurrence.

H K had a large pedunculated papilloma. Diagnosis was controlled by biopsy. Patient cured by fulguration and remained well for 2 years as shown by cystoscopic control. In third year a new papilloma was discovered arising from the sphincter margin. At operation the papilloma was excised and base was destroyed by surgical diathermy. Pathological examination showed papilloma.

M M, man aged 60 years, had suffered from hæmaturia 5 years. Papillary and solid growth occupied the right wall of the bladder and extended down almost to the bladder neck. Areas of necrosis and ulceration were noted. Clinical diagnosis was carcinoma. Five specimens punched out from different parts of growth showed papilloma. At

TABLE II — PAPILLOMA BIOPSY REPORTS
CONFIRMED

| Number of tumors in bladder | Con- firmed by early cysto- scopic control | Con- firmed by opera- tive speci- men | Con- firmed by cysto- scopic control (1 to 15 yrs) | Con- firmed by late cysto- scopic control | New tumors or recur- rences benign only 23 per cent |
|-----------------------------|-----------------------------------------------------------|------------------------------------------------------|----------------------------------------------------------------------|----------------------------------------------------------|-----------------------------------------------------------------------|
| Single | 29 | 6 | 26 | 1 | 22 |
| Pedunculated | | | | | |
| large | 26 | | | | |
| Pedunculated | | | | | |
| small | 25 | | | | |
| Sessile | 5 | | | | |
| Total | 56 | | | | |
| Multiple | 24 | 4 | 9 | | 7 |
| Pedunculated | | | | | |
| large | 7 | | | | |
| Pedunculated | | | | | |
| small | 16 | | | | |
| Sessile | 2 | | | | |
| Total | 25 | | | | |
| Papillomatosis 9 cases | 1 | 5 | 5 | 2 1 autop- sy 5 yrs After cure | 2 |

operation a growth the size of a peach was resected with full thickness of the bladder wall. On examination it was found to be a solid sessile papilloma with no atypism or infiltration. Control cystoscopy, 2 years later, showed no evidence of recurrence.

Dr M presented a small papilloma which was corroborated by pathological examination. Patient was cured by endovesical fulguration. Cystoscopy 4 years later showed no recurrence. Cystostomy was done for prostatic obstructing adenoma. No evidence of recurrence was found. Patient died of bilateral renal infection.

J S, a man of 60 years, was treated successfully by fulguration for a large papilloma, which was confirmed by three biopsies. Patient was readmitted to hospital 4 years later for hematuria due to bleeding from a prostatic adenoma. Cystoscopy showed no recurrence of vesical tumor. He now presented an epithelioma on the dorsum of the right foot.

S S, a man presented a large papilloma which was proved by biopsy and destroyed by high frequency in 1920. Small recurrences at the original site required treatment at intervals for 2 years thereafter. Three years after the last recurrence the bladder was free of any vestige of tumor.

I B was treated in the out patient department for several small tumors at the base of the bladder. Biopsy showed papilloma. Fulguration caused necrosis of the tumors but left areas of incrustated cystitis which finally necessitated curettage through a cystostomy wound. In spite of this treatment incrustation recurred and the patient was lost from observation.

K C, a man of 59 years, came under our observation in 1921. Nine years before that a bladder tumor had been removed by a general surgeon at another hospital. Five days ago hematuria had recurred for the first time. He presented papillary tumors on the anterior wall the fundus, and about the sphincter. Two biopsies showed papilloma. His treatment was sporadic and the development of other tumors occurred. In 1926 he consented to open operation and by means of the endotherm knife, a half dozen large papillomata were excised with the mucosa surrounding their bases. The pathological examination showed remarkable uniformity of structure, no evidence of malignancy or infiltration. On the twelfth day after operation patient died of pulmonary embolism. As his history stated that hematuria preceded his first operation by 7 years, he apparently had papillomata of the bladder for a period of 21 years without developing malignant changes.

A H, a man of 62 years had a benign pedunculated papilloma removed surgically in 1920. Small scattered growths recurred soon thereafter and then were treated by fulguration by the operator before the patient came to our clinic. He presented small papillomata about the right ureteral orifice on the posterior wall and in the scar at the fundus of the bladder. Several specimens were removed and were reported papilloma (Fig. 4). The tumors were gradually destroyed by fulguration in the course of 6 months. In 1927, 4 years after his last treatment, he died of other causes at the Montefiore Hospital. An autopsy performed there showed no tumors in the bladder. However, the mucosa was thickened and presented numerous cystitis cystica lesions. This case presents papillomatosis following surgical (cutting) removal of a single papilloma.

B S, a man of 56 years was admitted to Mount Sinai Hospital, in 1916 for frequency and dysuria. In 1913 he had been operated upon at another hospital for a tumor of the bladder. He now presented a ring of papillomata encircling the sphincter and papillary tumor buds at the site of the scar in the fundus. A typical extrapontoonal exploration of the bladder was made and a condition of

papillomatosis found and dealt with by thorough Iaquelin cauterization. No pathological examination was made at this time. Cystoscopic control carried out for 4 years showed no recurrence.

In 1923, however, he again came under observation for hematuria and presented a large sessile papilloma occupying a great part of the right lateral wall. A biopsy showed no evidence of malignancy, but it was deemed advisable to carry out a resection of the tumor bearing area. The operative specimen was a broad based, sessile papilloma the cells of which while larger than usual showed remarkable uniformity, no atypism and no infiltrating tendencies (Figs. 2 and 5).

In 1924 because of recurring suprapubic extravasation infection and fistula formation, an opportunity to explore the bladder was offered and no recurrence was found. A perineal prostatectomy for fibro adenoma of the lateral lobes accomplished healing of the fistula. A cystogram taken later showed distortion of the bladder resulting from the resection and bilateral vesicorectal reflux. Cystoscopic examination 3 years after the resection showed no recurrence. The patient is symptomatically well at the present time but attacks of pyelonephritis due to reflux caused by bladder irrigation or cystoscopic examination have made further investigation inadvisable.

This case illustrates again the long course which patients with papilloma of the bladder may present. He began with a single tumor—a single large tumor for which a successful resection was carried out—developed papillomatosis, and after this was cured. For 15 years he has been fortunate enough to escape malignancy.

PAPILLOMA REPORTS PROVED INCORRECT

In 7 additional cases the original pathological report of papilloma made upon specimens removed either through the cystoscope or at open operation was proved incorrect by subsequent events.

CASE 1. K. C. had a single large papillary tumor of the bladder. A few small fragments removed through the cystoscope were diagnosed papilloma June 6, 1914. Dr Hyman reports that the tumor did not respond to fulguration and that the man died a year later with the evidences of spinal metastasis. On reviewing the biopsy specimen large cells with large nuclei and mitotic figures were observed which suggested papillary carcinoma and should have led to a request for more material.

CASE 2. II H, a man of 39 years had a huge papillary tumor filling the bladder. Two adequate biopsies were made and a diagnosis of papilloma was rendered. The operative specimen consisted of a tumor about 10 centimeters in diameter arising by a broad base from the right lateral bladder wall. Although the histological picture was predominantly that of papilloma, scattered areas of large atypical and multinucleated cells were observed. The base was not infiltrated. The diagnosis was therefore papillary carcinoma (type 2a).

Reviewing the biopsy specimens similar atypical areas were now noted (Fig. 6) and the diagnosis should have been made upon this basis.

CASE 3. J. H. presented himself with a large papillary tumor of the bladder, biopsy of which showed a rather solid papilloma with marked inflammatory reaction. As the tumor failed to respond to fulguration a second biopsy was made and again the diagnosis was papilloma. Opera-

tion revealed a villous tumor the size of an orange arising from the anterior wall of the bladder but attached also to the base of the bladder in the region of the right ureteral orifice. The anterior half of the bladder was resected the attachment at the base of the bladder was coiled through with surgical diathermy, and radium emanation seeds were implanted in this area. Examination of the specimen showed invasion of the stalk and base of the tumor but presented only a few atypical areas in its depth. The tumor was therefore classified as papillary carcinoma (type 2d). The presence of these areas of atypical cells excluded it from the group of infiltrating tumors without atypism (type 2c). Careful review of the biopsy specimens disclosed no areas upon which the correct diagnosis could have been made, the atypical foci being confined to the depth of the neoplasm.

CASE 4. Joseph C. presented three fairly large tumors of the bladder. Fulguration was employed. Biopsy of only one tumor was made, and reported papilloma. Patient developed a fatal uraemia due to pyelitis. At postmortem examination two tumors, one in either paratrighal region proved to be papilloma. The third tumor, sessile and posttrighal in situation, proved to be an infiltrating carcinoma (type 2f) the cells of which showed but little atypism.

CASE 5. Jacob C., with history of difficulty in urination, stoppage, and hæmaturia for 5 years, was operated upon by a general surgeon (February 15, 1917) for prostatic obstruction, cystoscopy not having been done. Numerous papillomata were found and a specimen removed was reported to be a papilloma. A cautery destruction of the tumors was undertaken secondarily (March 6, 1917) and removed tumor tissue again was diagnosed papilloma. At a third operation soon afterward (March 16, 1917) a section of the bladder wall was submitted for examination. This showed infiltration of the muscularis and perivesical tissue by a papilloma type of growth. The diagnosis was therefore papillary carcinoma (type 2c).

CASE 6. H. L., admitted for profuse hæmaturia, presented on cystoscopy a large papillary tumor with broad base on the left lateral wall and numerous smaller growths near the vesical neck. Specimens removed with the cystoscopic forceps showed the histology of papilloma. Fulguration failing to control the hæmaturia the cautery operation recommended by Dr. Beer was resorted to. The large growth was excised with the cautery, the numerous smaller ones were destroyed *in situ*. Unfortunately, the large tumor was lost and therefore not examined. Cystoscopic examination before discharge showed a small recurrence on the left side of the bladder which was thoroughly fulgurated. Several small buds had appeared behind the trigone and treatment of these was begun. Another biopsy was done and the report was papilloma.

Nine months later he was readmitted for pain, stiffness and weakness of the right thigh. A tender prominence was noted in the region of the right os pubis and X-ray examination, which had been negative before operation, showed a destructive lesion. On cystoscopic examination a few small, sessile buds were seen at the fundus, biopsy of which was reported as papilloma. Nothing suggesting malignancy was found in the bladder at this time. A specimen removed from the pubic bone proved to be carcinoma of the transitional cell type.

Whether the large bladder tumor which was lost contained the source of this metastatic tumor remains unknown. The bladder showed no clinical evidence of local recurring malignancy. In the absence of an autopsy the case is not complete,

but it is most probable that the large tumor, which unfortunately escaped examination, was a papillary carcinoma.

CASE 7. F. McL., a man of 33 years, had been under treatment at another city for a papillary tumor of the bladder. Although originally only the size of an acorn the tumor had spread despite six fulguration treatments. He now presented two large growths on the right side of the bladder, sessile and partly solid in appearance, surrounded by a zone of oedema. One was partly necrotic. A biopsy (January 27, 1922) was reported papilloma. High frequency therapy was therefore continued, the bladder being apparently free of tumor on April 13. A month later the right half of the bladder seemed oedematous and a few flat growths in this area were treated. Six months later (October 1922) a similar appearance was noted and a second biopsy was reported papilloma, hypertrophied inflamed mucosa, and submucosa.

On March 19, 1923, a number of papillary growths and oedema of the right bladder wall down to the vesical neck were observed. A third biopsy was done and the report was papilloma, but operation was deemed advisable. The mucosa of the involved area was found thick and velvety with three small flat growths. The Paquelin cautery was applied thoroughly. On September 30, 1923, cystoscopy revealed an intense cystitis, a few nodules at the vault, and a small calculus. The latter was crushed and evacuated.

On February 22, 1924, thickened tissue about the right ureteral orifice was punched out for examination and reported as papilloma by another pathologist. Fulguration was again undertaken. On July 12, 1926, the patient once more came under observation for a papillary growth on the right side of the bladder, and the report of the fifth biopsy in the case was papillary carcinoma. At operation the growth involved the right wall and bladder neck. Diathermy and radium were employed. A specimen excised at this time showed infiltrating papillary carcinoma (type 2f). The patient ceased 6 months thereafter.

The course of this case strongly suggests that the condition was a malignant one from the onset and that the repeated reports of papilloma upon the biopsy material misled the clinician. On reviewing the slides I found, in the very first biopsy, areas of atypical cells. The second biopsy showed nothing to suggest malignancy. The third and fourth biopsies were definitely carcinomatous with invasion of the stroma (type 2d). The final stage was that of infiltration of the muscularis. Three of the original pathological reports were incorrect, and undoubtedly contributed to inadequate treatment of the lesion in its earlier stages.

In reconsidering these cases, therefore, papillary carcinoma should have been suspected or definitely diagnosed from tissue obtained cystoscopically in Cases 1, 2, and 7. In Case 3, the diagnosis could not be made from the superficial tumor tissue removed for biopsy. The operative specimen showed only a few deeply situated areas of atypical cells, but infiltration of the stroma and base definitely established the malignant nature of the growth. In Case 4, the bladder contained three tumors, two benign and one ma-

lignant. The biopsy specimen was probably derived from one of the benign tumors. Cases 5 and 6 illustrate the malignant course which papillomatosis may pursue. Infiltration of the bladder wall may not be detected even at operation. In Case 7, however, carcinoma should have been suspected at the first biopsy and definitely diagnosed at the third biopsy.

PAPILLOMA WITH SUBSEQUENT CARCINOMA

In 4 cases of papilloma diagnosed by biopsy and corroborated by other facts, carcinoma of the bladder developed later. Such instances add to the complexity of the subject.

CASE 8. S. C. was under observation since 1914. His history presents a remarkable sequence of events. In July 1914 he first came to the out-patient department for treatment of hæmaturia. A single papilloma of the bladder was found and treated by fulguration. When the growth had been destroyed down to its base a specimen from the latter was punched out for microscopic examination. It showed the inflamed connective tissue stalk covered in part by typical epithelium of benign papilloma type (Fig. 7).

The patient was free of symptoms but not controlled cystoscopically until November, 1918. At this time he returned to the clinic for frequency, dysuria and terminal hæmaturia of 4 months duration. He presented (1) a large papillary tumor hiding the right ureteral meatus (from view) (2) two small growths in the midline behind the inter-ureteric ridge (3) a pedicled tumor arising about $\frac{1}{2}$ inch above and lateral to the left ureteral meatus, (4) a larger tumor which seemed to arise from the right lateral wall further back in the bladder. There was no induration per se. Specimens removed from three of the tumors showed the histology of typical papilloma (Fig. 8).

High frequency treatment was begun, and the left lateral growth was burned off at its pedicle at the third sitting. Frequency, severe dysuria and bleeding ensued and induration above the left lobe of the prostate appeared. Pseudocystitis was diagnosed and open operation was decided upon.

At operation November 29, 1918 a small perforation of the bladder and local pseudocystitis were found and were undoubtedly the result of too vigorous d'Arsonval therapy. A large tumor on the right side with broad pedicle was excised through its base with the cautery. Several smaller growths were burned to a crisp *in situ*. The large tumor proved to be a papilloma. Control cystoscopy July 1919 showed no evidence of tumor.

On August 15, 1921 he returned for hæmaturia of 2 weeks duration. Cystoscopy showed two papillary growths paratrifurcal in situation and a more solid sessile growth at the fundus. With fulguration the two former disappeared but the latter resisted the current and a biopsy was therefore made. This was diagnosed papillary carcinoma (type 2b Fig. 9).

On November 28, 1921 a resection of the fundal part of the bladder bearing the carcinoma was performed and the specimen confirmed the diagnosis. It showed bowenoid stroma and submucosal base invasion with a tendency to squamous cell type of growth (2f Fig. 10). This illustrated the fact that the biopsy, while indicating the malignant nature of the growth could not be relied upon to determine invasion of the bladder wall.

Control cystoscopy in 1922 and 1923 showed no evidence of recurrence. On October 21, 1924 however a small

papillary growth at the fundus was observed and was removed with the punch forceps. The base was then fulgurated. Microscopic examination showed it to be a benign papilloma (Fig. 11). This treatment was adequate for three control cystoscopies have shown no recurrence.

To summarize the patient presented the following order of events: 1914 single papilloma biopsy responded to high frequency; 1918 multiple papillomata biopsy confirmed by operative specimen; 1921, three tumors two yielding to fulguration. Tumor at fundus which did not respond biopsy diagnosis of papillary carcinoma confirmed by operative specimen; 1924 small papilloma biopsy; and cure by fulguration, 1928 free of recurrence three cystoscopic controls.

CASE 9. A. H. a man of 33 years was treated in 1917 for a single papilloma of the bladder by fulguration biopsy having confirmed the clinical diagnosis. In 1920 hæmaturia recurred and cystoscopic examination showed a condition of papillomatosis. A biopsy was reported papilloma. At operation May 3, 1920 one large pedicled tumor was found on the right lateral wall and excised numerous small growths scattered throughout the bladder were destroyed with the cautery. The operative material was also diagnosed papilloma. Recurrences were found cystoscopically in a few months. Because of a urinary fistula which opened and closed and the appearance of a growth at the fundus a second operation was undertaken March 21, 1921. The sinus was excised but showed no growth. A large tumor on the anterior wall and smaller ones of the lateral walls were treated with cautery. Material removed for examination was again reported papilloma.

Postoperative recurrence a year later was treated by high frequency but a third operation August 13, 1923 became necessary. An infiltrating tumor of the posterior wall extending up to the sinus tract was implanted with radium emanation seeds. Tumor tissue obtained at this time showed a papillary carcinoma invading the submucosa at the base with small dark staining cells. Having reviewed the previous reports of papilloma myself the old slides were reviewed. The original biopsy material in 1917 unquestionably showed papilloma. The biopsy of 1920 showed on careful search an area of stroma invasion which had been overlooked and the operative specimen showed invasion of the stalk in the tumor which had been excised. This also had been missed. The operative material of 1921 showed no tumor involvement of the sinus tract but the bladder tumors showed areas of atypical cells and tumor cells in vascular and lymphatic spaces. The biopsy of a recurrent tumor in July, 1922 had been reported papilloma by another pathologist and on reviewing this slide I again found stalk invasion. It is apparent that the importance of looking for stroma and stalk invasion had not been sufficiently impressed upon me at the time of the original examinations. The diagnosis of carcinoma should have been made in 1920 and in each instance thereafter.

Small recurrences in the bladder and posterior urethra occurred and were treated palliatively by fulguration. The right kidney had to be removed for pyonephrosis. X-ray therapy was employed but the patient died in February, 1926 9 years after the discovery of the first bladder tumor.

CASE 10. H. S. a man of 43 years gave a history of hæmaturia at intervals for 6 months. Cystoscopy October 1922 showed a small papilloma on the right margin of the sphincter and a large papillary tumor lateral to the left ureteral orifice. The pedicle seemed broad and the surface showed some incrustation. An adequate biopsy obtained from this tumor showed papilloma. Four treatments with d'Arsonval current caused complete disappearance of the lesions. A control cystoscopy 4 months later gave no

evidence of recurrence. The patient did not return for further examination until 5 years later (1927) when he observed blood in the urine.

A small, flat, papillary tumor mesial to and above, the left ureteral orifice was found, and the dorsal current was applied. A week later a flat necrotic ulcer was found at the site of the tumor with small papillary excrescences at the lateral margin. Specimens removed from this area showed inflamed bladder wall with downgrowing buds and epithelial inclusion nests and cysts, regarded as an inflammatory reaction phenomenon. A month later the fulgurated area was found healed but small nodules at the margin were again observed. Three weeks thereafter an ulcer had reappeared at the site of the tumor and the mucosa between this and the ureteral orifice was velvety and thickened. Specimens from the ulcer margin and the thickened mucosa showed papillary carcinoma.

Operation was performed subsequently by Dr. Squier, who found a resectable papillary carcinoma requiring a left ureteroneostomy. If a biopsy had been made at the time the new tumor was discovered, it is probable that its malignant nature would have been detected at once.

CASE 11. R. T., a man of 56 years, in 1916 had been treated by fulguration elsewhere for bladder tumor. Four years later (1920) hematuria recurred, for which he was treated at another hospital, and was then admitted to Mount Sinai Hospital. At cystoscopy an inflamed bladder with an elevated trigonal region was found as well as a small papillary growth on the trigone near the right ureter orifice. Examination per rectum disclosed considerable induration and enlargement of the prostate, so that the possibility of malignancy was seriously entertained. Biopsy of the bladder tumor, however, was reported papilloma. At operation the small growth was excised with the cautery and on examination proved to be a papilloma. In the prostate was an abscess which was drained and tissue removed from the abscess wall showed purulent inflammation. This explained the impression which the rectal examination had given.

Five years later (1925) the man returned to the hospital for recurrence of hematuria, dysuria, etc. He now presented an extensive, infiltrating flat carcinoma involving the anterior wall of the bladder. The resected tumor was a scirrhous cancer (type 3a). The patient died 6 months later with metastases to the peritoneum, omentum and inguinal nodes.

In Cases 8 and 11, it seems beyond reasonable doubt that the carcinomata developed in the bladder at a time and situation sufficiently remote from the original benign papilloma to establish their independent origin. In Case 10, although the first and second tumors occurred in the same part of the bladder, the interval of 5 years and the marked difference in their response to fulguration point to their independence. In Case 9, it is possible that the original tumor was one of early carcinoma although a careful review of the biopsy gives no evidence of it. It also responded to fulguration, whereas the later growths did not yield to such treatment and the microscopic examination confirmed their malignancy.

Of all the patients studied these four alone were afflicted originally with papilloma and subsequently with carcinoma. In one case only

(Case 10) did the malignant growth arise at the site of the first (benign) tumor. In other instances in which this sequence seemed to have occurred (Cases 5, 6, 7, 12, 13, 20, 21), a review of the material proved either that minute changes of malignancy had been overlooked in the original biopsy or that the case was one of papillomatosis. On the contrary, patients with papilloma have been observed for 20 years without development of malignancy.

SOURCES OF ERROR IN BIOPSY DIAGNOSIS

From what has been said it is evident that a biopsy report of papilloma may be rendered by the pathologist in some cases of carcinoma of the bladder for the following reasons, unavoidable on his part:

1. Insufficient material, or improper material such as fulgurated tumor tissue.

2. In the rare cases of infiltrating tumors of benign cell type (group 2c), the diagnosis cannot be made unless tissue has been removed from the infiltrated base.

3. Co-existence of benign and malignant tumors in the same bladder, material from the benign lesion alone being submitted (as in Case 4).

4. The malignant cell changes may be confined to the depth of the tumor inaccessible to biopsy (Case 3). Contrary to general belief this is exceedingly rare.

5. Cases of papillomatosis in which it is evident that only a few of the numerous tumors are examined, and a malignant one may readily be missed (Cases 5 and 6).

PAPILLARY CARCINOMA

Of the three groups of common bladder tumors, the papillary carcinomata constitute the most numerous. Of 285 bladder tumors considered in this paper, 142, about 50 per cent, belong in this group. Ten of these have already been reported in some detail. Of the 142 papillary carcinomata, 26, or more than 19 per cent, were multiple tumors. The statement is frequently made that multiplicity speaks for benignancy. Of the benign tumors in this series, 38 per cent were multiple. Multiplicity was therefore only twice as common in benign as compared with malignant papillary growths.

For important practical purposes the non-infiltrating papillary carcinomata should be considered separately from the infiltrating papillary carcinomata. The former are usually indistinguishable cystoscopically or grossly from benign papillomata. They may be pedunculated or sessile, single or multiple. The cytological changes

which brand the tumor as malignant may be very slight and limited to a small part of the growth, or very marked and present throughout the growth. These changes are the presence of large cells with irregular deeply staining nuclei, cells with atypical mitoses, pyknotic nuclei or lobulated nuclei, intensification of cell membranes with tendency to squamous type, loss of palisade arrangement, loss of uniformity. The stroma is not invaded and the basement membrane is preserved.

Infiltrating tumors comprise two types. The first is characterized by a cell growth indistinguishable from that of benign papilloma, yet the tumor invades the pedicle, infiltrates the bladder wall and its vessels, and may produce distant metastases. This is the only bladder tumor to which the term "malignant papilloma" may be applied with justification. The second type presents all the cellular aberrations observed in the non infiltrating tumors with a more marked tendency to squamous metaplasia. The tumors show invasion of the pedicle, the bladder wall, and perivesical tissues. Frequently the papillary portion of the growth almost completely disappears by necrosis and leaves the ulcerated infiltrated base with a few papillary excrescences at the edge.

BIOPSY DIAGNOSIS OF PAPILLARY CARCINOMA

In the examination of snippings of vesical tumors removed through the cystoscope for diagnosis, the pathologist should adopt the mental attitude of "Guilty until proved innocent." Every fragment available must be examined critically and leisurely, not when pressed for time. As experience grows larger and the opportunity to check up the diagnosis increases, one becomes more and more convinced of the significance of slight cellular irregularities, loss of palisade arrangement, tendency to squamous metaplasia, variations in size and shape of the nuclei, pyknosis, prominence of nucleoli, and atypical mitoses. Breaking through of the basement membrane, stroma infiltration by epithelial cells and their presence in the small blood vessels of the core, should always be searched for. If the base of the mucosa adjoining the pedicle has been reached by the rongeur forceps, submucous or even muscular infiltration may be detected. In some instances, a positive diagnosis of malignancy cannot be made from the first biopsy but the pathologist should indicate the suspicion he entertains and request more material.

Tumors of the groups 2 a, b, c, and d are frequently indistinguishable from benign papilloma by cystoscopic inspection alone. The dif-

ficulty of diagnosing tumors of type 2c, fortunately rare, has already been indicated. The occasional favorable response to high frequency treatment is no conclusive argument for the innocence of the tumor. The case records show how often it has misled the urologist and delayed his resort to biopsy and adequate treatment of the lesion. Of 30 cases in groups 2a and 2b, high frequency alone succeeded in only 4 cases. In all fairness it must be stated that except in patients very advanced in years or suffering from constitutional disorders, the biopsy diagnosis of carcinoma has been a signal for us to discontinue this treatment. On the other hand 12 cases of papillary carcinoma treated by high frequency with apparently good immediate result suffered early recurrence at the same site or ulcerative lesions at the base, all of which were proved malignant by pathological examination. Very many cases came to the hospital after varying periods of futile and repeated fulgurations for tumors which could have been diagnosed at the first examination had a biopsy been made.

It should be emphasized that microscopic evidence of infiltration is much more frequent in papillary carcinoma than is clinical evidence of infiltration obtained by cystoscopic inspection, bimanual palpation, or operative investigation. In 138 cases of papillary carcinoma, clinical indications of infiltration were present in about 50 per cent, but histological evidence of invasion was found in 108, or 78 per cent. If biopsy in a case of papillary tumor proves it to be carcinoma and surgery is decided upon, segmental resection of the entire thickness of the bladder wall and the underlying perivesical fat should be carried out even if clinical signs of infiltration are lacking.

ILLUSTRATIVE CASES OF PAPILLARY CARCINOMA

To clarify the description of the various forms of papillary carcinoma which present themselves to the clinician and the pathologist, and to emphasize the value and limitations of the biopsy, a number of cases are herewith briefly reported and photomicrographs of the material are presented.

CASE 12. A W, a man of 51 years, with painless terminal hematuria presented a pedunculated papillary tumor the size of a plum arising from the left lateral wall. The biopsy showed areas of typical papilloma structure and a more solid part (Fig. 12) made up of larger cells with well defined limiting membranes and nuclei of varying size and staining reaction. From this examination a diagnosis of papillary carcinoma type 2a could be made. For a time fulguration seemed effective but 6 months later

operation became necessary and multiple small tumors were found scattered over the mucosa and an infiltrating tumor was found at the base. As resection was out of the question, the cautery and radium were applied. A specimen removed from the tumor at the base showed an infiltrating papillary carcinoma (type 2f). The patient ceased 9 months thereafter. Dissemination as a result of fulguration seems most probable. The rapid course of the disease was surely not indicated by its histology.

CASE 13 R G, a woman 48 years of age, was operated upon, in 1912, for a bladder tumor. It was described as a papillomatous tumor the size of a walnut pedunculated, and situated near the left ureteral orifice. The tumor came away when gentle traction was applied to it. There was no evidence of infiltration. The site of attachment seems not to have been cauterized. Examination of the specimen showed a solid type of papillary growth with very little stroma. The cells were of benign type except for one area, which showed large irregular nuclei and atypical mitoses (Figs 13 and 14). The tumor was therefore a papilloma which had developed into a papillary carcinoma, type 2a. A few months after the operation multiple small recurrences were observed in the bladder for which endovesical high frequency was employed apparently with good effect.

In 1914, 2 years after operation, she was readmitted for an abdominal mass which proved to be metastatic carcinoma in the omentum (Fig 15). Cystoscopy at this time showed small papillary growths at the fundus of the bladder in the region of the previous cystostomy scar. No pathological examination of these was made. The subsequent course of the patient is not known.

CASE 14 H S, a male of 54 years, who had a "polyp" of the bladder destroyed by high frequency treatment in 1908, returned for hematuria early in 1917. Two papilloma were seen on the left wall of the bladder and fulguration was begun without removal of a specimen. Despite regular and persistent treatment the result was not satisfactory. A biopsy made on August 9, 1917, was reported as papilloma with atypical cells probably malignant. On examining this slide (Fig 16) I made an unequivocal diagnosis of papillary carcinoma (type 2a).

At operation November 22, 1917 a pedunculated tumor was removed by clamping and cutting the pedicle and then cauterizing the site of origin with the Paquin cautery. The specimen was a papillary carcinoma with invasion of the stroma and stalk (Fig 17). Tumor cells were seen in a lymphatic space. Here again the biopsy gave no clue to the extent of the lesion but did show its malignancy.

Two years later biopsy of a recurrent growth (Fig 18) again showed papillary carcinoma. Five months later a right nephrectomy for pyonephrosis and partial cystectomy were performed. Tumor was found in the suprapubic scar tissue. The muscularis of the resected bladder wall was infiltrated (Fig 19). Bony metastases supervened before death of the patient. It is evident that the first operative intervention was inadequate and not planned in accordance with the knowledge of malignancy derived at biopsy.

CASE 15 M H, a man of 61 years operated upon for bladder tumor, presented a papillary growth the size of a large walnut springing by a narrow pedicle from the trigone near the urethral orifice. The surgeon excised the tumor through the mucosa about the pedicle. A sagittal section through the growth and its pedicle (Fig 20) showed its architecture to be that of papilloma but the pedicle presented an area of submucosal infiltration (Fig 21) by cells which were closely packed with dark staining nuclei and were undoubtedly tumor cells. The neoplasm must therefore be classified as a papillary carcinoma, type 2c. Unfortunately the subsequent history of this patient is not known.

CASE 16 E E, a man of 59 years, had hematuria 18 months and 3 weeks ago. On cystoscopic examination a papillary tumor, the size of a plum, arising from the left wall of the bladder and overhanging the left ureteral orifice was found. Some parts appeared more solid than others. No biopsy was made. At operation the growth was destroyed by surgical diathermy down to its base and the tumor area was resected and the lower end of the left ureter was removed. The proximal end of the ureter was reimplanted. Examination of the resected bladder wall (Fig 22) showed remaining areas of viable papilloma tissue which had not been destroyed by diathermy. Islands of similar cells, not atypical in appearance, were found in the submucosa and in the more superficial part of the muscular coat. As to the structure of the main body of the neoplasm nothing can be said as it was destroyed in the course of the operative intervention. From the material at hand the growth must be classified as papillary carcinoma, infiltrating type 2c. The case is too recent to make any statement as to end result. A cystoscopy 3 months after the resection showed no recurrence.

CASE 17 D K, a man of 56 years, had hematuria 15 months ago. A urologist found a bladder tumor which he treated by fulguration. Although hematuria did not recur, pain and frequency persisted. Cystoscopic examination now showed an *œdematous tumefaction* of the posterior bladder wall suggesting infiltrating carcinoma. Three specimens were removed from the right edge of the lesion and reported as bladder wall showing islands of infiltrating tumor cells, papillary carcinoma type 2d (Fig 23).

At operation a large part of the right lateral and posterior wall of the bladder felt thickened, and was resected, although no definite tumor was seen. On careful examination in the laboratory a tiny growth 2 to 3 millimeters in diameter was detected at one edge of the inflamed bladder wall. This proved to be the pedicle of the neoplasm for which the patient had been treated (Fig 24) and from which the biopsy specimen had fortunately been obtained. Columns and nests of small pyknotic tumor cells grew in the fibrous tissue of the pedicle.

CASE 18 I Z, aged 45 years, had hematuria at intervals for 9 months. The prostate was considerably enlarged and firm but smooth. Cystoscopy showed a papillary growth arising from the right side of the bladder neck. Several fragments were removed for pathological examination. All but one presented the typical structure of papilloma. This one fragment (Fig 25) was a frond, the covering epithelium of which was benign in appearance. The stroma, however, contained large numbers of irregular cells with nuclei of various sizes and shapes and staining reactions. The tumor was therefore a papillary carcinoma type 2d. The patient soon thereafter developed a staphylococcus aureus sepsis and died. As no autopsy was obtained the extent of the infiltrative tendency of the tumor cannot be stated. The case illustrates the fact that all parts of the growth are not the same in structure or type and that adequate material must be secured.

CASE 19 J K, had a papillary tumor arising from a broad base near the left ureteral orifice. A biopsy taken after fulguration had been instituted showed degenerated tumor tissue and more material was requested. The clinician, however, did not comply with this request because the growth yielded well to the treatment. It melted away rapidly leaving an ulcer at the site of its base. A biopsy taken from the edge of the lesion, 2 months after treatment had been started, showed submucosal invasion by tumor cells. The mucosa itself presented small atypical papillae (Fig 26).

At operation a superficial ulcer 2.5 by 3.5 centimeters was found with extensive perivesical induration and

TABLE III—SUMMARY OF TWO HUNDRED EIGHTY-FOUR CASES STUDIED

| Type of tumor Number of cases | Biopsy done | Biopsy errors | No treatment | Cytoscopic treatment | Operative treatment | Operative treatment plus radium | Operative deaths | Deaths due to the disease | Deaths due to other causes | Recurrent or new tumors | | Metastases | Number cases followed—182 | Number cases arrested | Percentage arrested |
|-----------------------------------------------------------------------------------------------------------------------------------------|-------------|---------------|--------------|----------------------|---------------------|---------------------------------|------------------|---------------------------|----------------------------|-------------------------|------------------|---------------------------|---------------------------|-----------------------|---------------------|
| | | | | | | | | | | Benign | Malignant | | | | |
| I Papilloma Single 16 Multiple 15 Papillomatous 10 — 91 | 90 | 0 | 0 | 22 | 23 | 0 | 5 | 0 | 4 | 12 | 1 | | 60 | 45 | 80 |
| II Papillary carcinoma Non-infiltrating A Single 9 Multiple 5 — 14 | 12 | 3 | 2 | 6 | 5 | 1 | 0 | 2 | 1 | 1 | 2 | seminal vesicle | 9 | 4 | 44 |
| B Single 14 Multiple 1 — 15 | 13 | 0 | 3 | 3 | 6 | 4 | 3 | 3 | 1 | 0 | | | 12 | 5 | 42 |
| Infiltrating C Single 4 Multiple 1 — 5 | 1 | 1 | | | 3 | 2 | 1 | | | 0 | 1-2 yrs | | 2 | 0 | 0 |
| D Single 30 Multiple 4 — 34 | 10 | 1 | 0 | 6 | 13 | 6 | 1 | 11 | 1 | 1 | 6 | 4 bones lungs | 15 | 1 | 10 |
| E Single 14 Multiple 1 — 15 | 11 | 1 | 1 | 2 | 11 | 5 | 0 | 5 | 1 | 1 | 1 | | 11 | 6 | 50 |
| F Single 44 Multiple 7 — 51 138 | 43 | 4 | 10 | 2 | 16 | 10 | 2 | 19 | 4 | 0 | 7 | 1 lung 1 bone | 16 | 5 | 14 |
| III Non-papillary carcinoma A type 1 B type 6 C type 7 D type 10 E type 4 (Multiple) — 44 | 35 | 0 | 10 | 1 | 19 | 4 | 0 | 13 | 1 | 0 | 0 (1 in scar) | nodes 6 bones prostate | 30 | 5 | 16 |
| Cases 6 7 9 10 4 cases primary prostatic carcinoma—1 myosarcoma 1 carcinoma in scar after operation elsewhere 1 adenoma 1 fibroma | 4 4 | 2 0 | | | | | | | | | | | | | |

* High frequency only 85 radium only 7 H F T plus radium 4

heaped up margins. The lesion extended about the region of the left ureteral orifice across the trigone almost to the right orifice. As it was deemed not resectable it was treated by implantation of radium emanation seeds. The patient made a satisfactory convalescence but a follow up was not obtained.

CASE 20. M. R. a man of 52 years admitted to the hospital in 1917 for hæmaturia at intervals for 3 years. He presented a large papillary tumor on the left side of the bladder for which fulguration was employed at first in the hospital and later in the out patient department. On four occasions during his treatment biopsies were made and examination in all revealed papilloma. After the superficial part of the growth was destroyed the base appeared solid and more resistant to the current. It is not clear from the records that it was ever completely removed during the year he was under treatment.

In 1920 he was admitted to the hospital for arterio-sclerotic gangrene of a toe. Some blood was noted in the

urinalysis. On cystoscopic examination a sessile papillary growth was found on the left side of the bladder extending toward the left ureteral orifice. A biopsy examination of the tumor proved it to be a papillary carcinoma with invasion of the stroma (Fig. 27). At operation a segmental resection of the bladder was performed with the cautery.

TABLE IV—END RESULTS IN BLADDER TUMORS, 182 CASES

| | Cases followed | Number arrested | Percentage arrested |
|-----------------------------|----------------|-----------------|---------------------|
| I Papilloma | 60 | 45 | 80 |
| II Papillary carcinoma | | | |
| Non-infiltrating | 27 | 9 | 43 |
| Infiltrating | 77 | 13 | 18 |
| III Non-papillary carcinoma | 30 | 5 | 16 |
| Total | 182 | 75 | |



Fig 17 Operative specimen showing stroma and stalk invasion, tumor cells in a lymphatic space November 22, 1917 Papillary carcinoma (type 2d) Case 14 $\times 45$

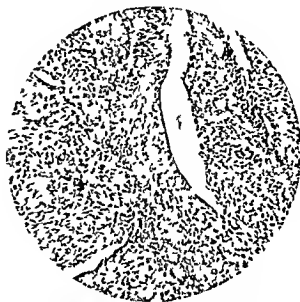


Fig 18 Biopsy specimen taken from case of recurrent papillary carcinoma December 8, 1920 Case 14 $\times 75$

As a sufficient free area existed between the left ureteral orifice and the growth, ureteroneostomy was not necessary. The resected tumor was a papillary carcinoma which extended into the submucosal connective tissue but did not involve the muscularis (Fig 18). During convalescence a small vesical calculus developed. An attempt to remove it cystoscopically under nitrous oxide anesthesia resulted in accidental perforation through the recent suture line of the bladder. Laparotomy for repair of this injury was successful. Cystoscopic examination of this patient in 1927 7 years after operation, showed no recurrence.

A review of the biopsy specimens removed in this case in 1917 when the patient first came for

treatment was interesting and instructive. Of the four examinations all but the second showed typical papilloma as originally reported. In the fragments of the second specimen was one area of atypical cells with mitoses, growing in the stroma of a frond (Fig 29). Upon this area, which was overlooked, a diagnosis of papillary carcinoma could have been made.

CASE 21 I R, aged 68 years, admitted to the hospital in 1918 for hematuria of 2 months' duration presented a solid looking tumor on the left inferolateral wall of the bladder. A very meager specimen submitted for biopsy



Fig 19 Operative specimen from case of recurrent papillary carcinoma infiltrating the muscularis Case 14 $\times 36$



Fig 20 Operative specimen of pedunculated papillary tumor with the architecture of a benign papilloma. Note pedicle, see next illustration Case 15 $\times 10$



Fig 21 Area of pedicle showing submucous invasion by tumor cells Papillary carcinoma (type 2c) Case 15 $\times 180$



Fig 22 Resected bladder wall showing some parts of the tumor which escaped destruction by diathermy Islands of tumor cells in the submucosa and muscular coat The cells themselves do not appear of malignant type Papillary carcinoma (type 2c) Case 16 $\times 30$

was reported as papilloma Fulguration was begun but the patient was lost from observation

In 1921 he was readmitted for hematuria and presented a large spherical solid looking tumor on the left side of the bladder Biopsy specimens (figs 30 and 31) showed undoubtedly papillary carcinoma with stroma invasion At operation only palliative cauterization of the infiltrating neoplasm was attempted The patient died in uræmia a week later

The case illustrates the error of reporting upon the insufficient material removed at the first biopsy

CASE 22 I T A man of 48 years was admitted for hypogastric tumor and dribbling of urine of 7 months duration Blood in urine had also been observed He was found to have cerebrospinal lues and chronic retention of urine The bladder was emptied gradually A cystogram showed a huge bladder with a filling defect on the left side Cystoscopy revealed a large papillary tumor which seemed to spring from the anterior wall near the sphincter and a more solid growth on the left lateral wall Biopsy specimens presented fragments of tumor tissue which for the most part appeared benign but there were areas of solid

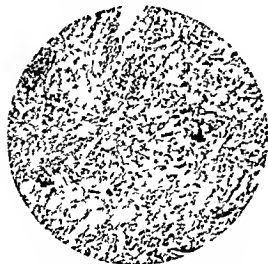


Fig 23 Biopsy section from edge of suspected tumor area Irregular dark staining cells growing between the strands of fibrous tissue are seen Papillary carcinoma (type 2d) Case 17 $\times 75$



Fig 24 The tumor pedicle found at edge of the resected bladder wall Small pyknotic cells in nests and strands growing in the fibrous tissue Papillary carcinoma (type 2d) Case 17 $\times 13$



Fig 25 Biopsy of a papillary tumor. Several fragments were typical papilloma. This fragment however showed a frond with malignant cells growing in the stroma. Papillary carcinoma (type 2d). Case 18. $\times 75$.

masses of cells irregular in shape, size, and arrangement, with tendency to squamous type (Fig 32). These atypical areas warranted the diagnosis of papillary carcinoma.

At operation there was found a papillary tumor the size of a peach with a broad pedicle, arising from the left side of the bladder, without gross evidence of infiltration. About a dozen smaller papillary growths were scattered on the anterior and posterior walls. The largest tumor was treated by surgical diathermy and then excised with its base by the endotherm knife. The base of the pedicle showed infiltration by tumor cells growing between the muscle fibers of the bladder wall (Fig 33). One of the smaller tumors removed in a similar manner presented



Fig 26 Biopsy from edge of large ulcer left after destruction of a papillary tumor by endovesical fulguration. Shows submucosal invasion by tumor cells. Papillary carcinoma (type 2e). Case 19. $\times 45$.

in its pedicle a fair sized vein adherent to the wall of which was a thrombus containing cancer cells (Fig 34). The patient had cystoscopic evidence of recurrence 8 months after operation. Treatment of the luteic condition had completely relieved the urinary retention.

NON-PAPILLARY CARCINOMATA

Non-papillary carcinomata are characterized by their tendency to spread from the surface of the bladder laterally under the normal mucosa and downward into the submucous, muscular,



Fig 27 Biopsy of sessile papillary tumor for which patient had been treated three years previously by fulguration. Papillary carcinoma (type 2d). Case 20. $\times 45$.

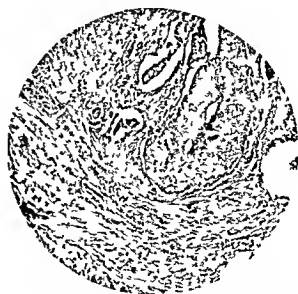


Fig 28 Photomicrograph of resected tumor showing submucosal invasion. Papillary carcinoma (type 2e). Case 20. $\times 45$.



Fig. 29 Area of atypical cells with mitoses growing in the stroma. From second biopsy when patient first came for treatment. Three other biopsies showed typical papilloma. Papillary carcinoma (type 2d). Case 20. $\times 240$.

and adventitial tissue of the bladder. They may arise in any part of the bladder but are commonly situated on the posterior wall or at the base involving the interureteric ridge, the trigone, and the vesical neck. Frequently ulceration and necrosis are present at the center of the growth the edge of which appears as a thickened, edematous heaped up margin. Occasionally a neoplasm of this kind appears simply as an elevated, localized thickened area of the bladder wall

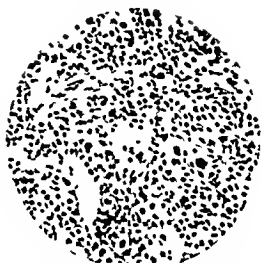


Fig. 30 Biopsy showing variation in size of cells and nuclei, irregularity of arrangement. Papillary carcinoma (type 2d). Case 21. $\times 190$.

which can be differentiated from an inflammatory process only by resort to biopsy, and even this may fail if the proper material is not obtained. Others project into the lumen of the bladder but are solid in appearance, lacking the fronds of the papillary tumors.

Ulcerated necrosed papillary carcinomata which have infiltrated the muscularis and the flat non-papillary carcinomata can usually be diagnosed by cystoscopy and bimanual palpation for infiltration. Although a biopsy may not give evidence of the true extent of the lesion nevertheless it is



Fig. 31 Another area of same biopsy specimen as in Figure 30 showing stroma invasion. Case 21. $\times 240$.

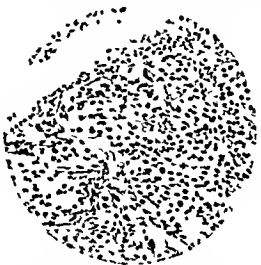


Fig. 32 Biopsy. Areas of solid nests of cells varying in size, shape and arrangement, irregular nuclei and mitoses. Papillary carcinoma (type 2a). Case 22. $\times 150$.



Fig 33 Operative specimen Infiltration of the base of the pedicle Papillary carcinoma (type 2f) Case 22 $\times 45$



Fig 34 Operative specimen Tumor cells in a blood vessel of a tumor's pedicle Case 22 $\times 80$

advisable to have histological evidence of malignancy before recommending radical surgery to the patient

Histologically, the flat carcinomata seem to arise from the deeper cells of the mucosa, nests of which are frequently seen dipping downward in inflammatory processes, especially at the trigone and vesical neck. The growth may present much fibrous tissue between the strands of small pyknotic tumor cells, the scirrhous variety (Fig 35) or they may be almost entirely cellular with large atypical cells and numerous mitoses,

the medullary transitional cell variety (Fig 36). The so called glands of von Brunn, cystitis cystica lesions, and embryonal rests may give rise to adenocarcinoma (Fig 37). Metaplasia, or more correctly prosoplasia, of the transitional epithelium of the bladder accounts for the squamous variety of carcinoma (Fig 38). The existence of leucoplakia in the bladder is a predisposing cause for squamous cell carcinoma. An ulcer on the anterior bladder wall less than a centimeter in diameter gave evidence of such change in the biopsy material (Fig 39). At



Fig 35 Biopsy specimen of fibrocarcinoma (scirrhous) (type 3a) Case 22 $\times 45$



Fig 36 Operative specimen medullary carcinoma (type 3b) $\times 45$



Fig 37 Biopsy Adenocarcinoma arising from the glands of von Brunn (type 3c) $\times 45$



Fig 38 Operative specimen Squamous cell carcinoma (type 3d) $\times 45$

operation it was found to be in an area of leucoplakia. The neoplasm had not yet involved the muscularis (Figs 40 and 41). In some instances well developed pearl formation occurs and a hornifying carcinoma results (Fig 42).

BIOPSY IN LESIONS SIMULATING NEOPLASM

A considerable variety of lesions of the bladder may simulate neoplasm and confuse even the most experienced cystoscopist. A biopsy may be invaluable therefore in avoiding therapy surgical or otherwise misdirected and even contra indicated for the case. As examples one may

enumerate the following: bullous oedema, cystitis cystica and glandularis, impacted ureter stone, polypoid tuberculosis of the ureteral orifice, leucoplakia with infection, incrustrated cystitis, inflammatory lesions and callous ulcers of the bladder. The reaction to oft repeated and over enthusiastic application of the high frequency method of treatment has produced at times a brawny infiltration simulating extensive, infiltrating carcinoma, and the failure to confirm the clinical impression by biopsy led to an unnecessary and in fact harmful resection of the bladder and ureter orifice in one of our own



Fig 39 Biopsy from small ulcer of anterior wall of bladder. Diagnosis of squamous cell carcinoma $\times 45$



Fig 40 Operative specimen in preceding case Squamous cell carcinoma (type 3d) $\times 45$



Fig 41 Leucoplakia of the bladder from which the carcinoma arose $\times 120$



Fig 42 Biopsy section from an inflamed hornifying carcinoma $\times 75$

cases A young woman was referred from the out patient department with the cystoscopic diagnosis of infiltrating carcinoma of the posterior bladder wall A biopsy showed edema and inflammation So closely did the lesion simulate neoplasm that two additional biopsies were made with the same result The history of an iodine douche accidentally entering the bladder and followed by immediate vesical symptoms was then elicited The lesion disappeared gradually without treatment

ASSOCIATED LESIONS, SECONDARY TUMORS

Patients with tumors of the bladder not infrequently present vesical calculi, prostatic hypertrophy, and vesical diverticula Diverticula occurred in 12 of the cases of this series and in 8 of these the tumor was situated either within the diverticulum or at its orifice Secondary involvement of the bladder by extension from a carcinoma of the prostate was suspected in 4 cases from the biopsy material and this was confirmed by the clinical findings and subsequent course

DIAGNOSTIC VALUE OF THE BIOPSY

In Table III a summary of the 285 cases analyzed in this study is presented Biopsy was performed by procuring tissue with the cystoscope in 242 cases An erroneous diagnosis was rendered upon the material submitted in 12 cases, about 5 per cent In my review of the original microscopic preparations, 7 of these reports were found to be true errors in that a correct diagnosis would be rendered today upon

the basis of accumulated knowledge and experience with this type of work In the 5 remaining cases the error was unavoidable for reasons already pointed out in the paragraph entitled "Sources of Error in Biopsy Diagnosis" Of the 242 cases a correct diagnosis, therefore, could be made in 237, about 97.5 per cent

PROGNOSIS

In Tables III and IV the end-results are noted in 182 cases in which the termination of the case is known or in which a follow up of not less than 3 years is available Only those cases are regarded as arrested in which the final cystoscopic control showed no evidence of recurrence and in which clinical examination showed no evidence of metastasis

If cytologic criteria alone indicated the prognosis, one would expect a decided difference in the number of arrested cases in groups II A (non-infiltrating carcinoma with slight atypism) and II B (with more diffuse and marked atypism) but the percentages are almost identical, 44 and 42 respectively

If bladder wall infiltration indicated the prognosis then group II F (papillary carcinoma infiltrating muscularis and perivesical fat) and group III (non-papillary infiltrating carcinoma) should show similar results, which is the case in this series, 14 and 16 per cent respectively

If one compares the non-infiltrating papillary carcinomata (II A and B) with the infiltrating papillary carcinomata (II C, D, E and F) the percentage of arrested cases is 43 and 18 per cent respectively (see Table IV) The unusually

good results obtained in group II F (papillary carcinoma with submucosal base invasion) is ascribable to the fact that in 7 of the 17 cases, an adequate segmental resection of the bladder was feasible.

Cases which present the cystoscopic or operative findings of papillomatosis are treacherous from the standpoint both of diagnosis and prognosis. Of 13 such cases in this series 9 were benign in their course and 4 proved to be malignant.

From what has already been said regarding our inability to determine the question of infiltration and extent of the lesion by biopsy alone and from the deductions drawn concerning the importance of infiltration in prognosis, it is evident that prognosis in bladder malignancy cannot and should not be attempted from biopsy material alone. For the individual patient the prognosis cannot be made on any single basis, all malignancy is grave for him.

CONCLUSIONS

1. Reliable information as to the nature of bladder tumors is obtained by cystoscopic biopsy in 97.5 per cent of cases. The unavoidable failures occur chiefly in multiple tumors and in papillomatosis.

2. Prognosis cannot be made from biopsy material alone in cases of malignancy.

3. A biopsy diagnosis of malignancy in a case simulating papilloma by cystoscopy and response to fulguration is a signal for more radical therapy (radium or surgery).

4. Bladder tumors may be classified in a manner harmonious with general tumor terminology and with clinical requirements. They are benign or malignant.

5. Classification based upon cell grading alone is not as practical for clinical purposes, and prognosis on such basis does not coincide with the late results in this series of cases.

6. The presence or absence of infiltration appears to be a more reliable guide to the gravity of the situation.

7. The site of the malignant tumor determines its resectability and thus influences prognosis materially.

8. If a biopsy diagnosis of carcinoma is made and the case is considered surgical, segmental resection of the whole thickness of the bladder wall is the procedure of choice. Failure to do so even in the pedunculated tumors has often resulted in recurrence. Strik invasion and tumor cells in the blood vessels at the base cannot be detected by gross inspection.

9. As only 30 of 138 papillary carcinomata showed no evidence of infiltration, it is probable that types II A and B represent an earlier stage in the development of the disease.

Although histological studies tempt one to believe that papillary carcinoma develops from papilloma in a considerable percentage of cases evidence thereof is very equivocal.

10. Before undertaking radical surgery for tumor of the bladder, a biopsy should be made, as other lesions may resemble neoplasm very closely.

My thanks are due to Dr. Paul Klemperer who checked up the microscopic diagnoses which I made and to Dr. Edwin Beer for use of the clinical data.

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CANCER OF THE BREAST

AN ANALYSIS OF ONE HUNDRED AND EIGHT CASES OF CANCER OF THE BREAST, A CLINICAL INDEX OF MALIGNANCY

JOHN G. STUBENBORD, 3RD, M.D., DOUGLASSON, LONG ISLAND, NEW YORK

From the First Surgical Division of New York Hospital Service of Charles L. Gibson, M.D.

THIS paper is based on a series of 108 consecutive unselected cases of cancer of the breast. They were taken from the First Surgical Division of the New York Hospital. The series represents all the cases diagnosed as cancer of the breast on this division from 1912 through 1928.

TABLE I—INCIDENCE

| Year | No. of cases of breast cancer | Cancer—all kinds (pathologically) (anatomically) | Total cases discharged from 1st surgical division each current year |
|-----------|-------------------------------|--------------------------------------------------|---------------------------------------------------------------------|
| 1912 | 1 | | |
| 1913 | 6 | | |
| 1914 | 9 | 28* | 997* |
| 1915 | 8 | 63 | 2,364 |
| 1916 | 9 | 48 | 1,698 |
| 1917 | 12 | 47 | 1,883 |
| 1918 | 6 | 45 | 1,514 |
| 1919 | 6 | 52 | 1,473 |
| 1920 | 3 | 26 | 1,482 |
| 1921 | 8 | 46 | 1,600 |
| 1922 | 7 | 102 | 1,691 |
| 1923 | 6 | 33 | 1,594 |
| 1924 | 5 | 40 | 1,506 |
| 1925 | 8 | 46 | 1,541 |
| 1926 | 2 | 40 | 1,516 |
| 1927 | 5 | 48 | 1,751 |
| 1928 | 7 | 52 | 1,793 |
| Total 108 | | 716 | 24,403 |

*For last 6 months only

For a 15 year period, 1914-1929, breast cancer was 15 per cent of all the cancer cases diagnosed and treated on this division. During this same period it represented 0.44 per cent of all the cases discharged from the service. It was a surprise to find only 108 cases diagnosed as cancer of the breast over this long period of years. Especially, since there is such a rapid surgical turnover each year on this division.

TABLE II—MARITAL INCIDENCE

| | Cases | Per cent |
|---------|-------|----------|
| Single | 21 | 19 |
| Married | 56 | 51 |
| Widowed | 31 | 30 |
| Total | 108 | 100 |

Cancer of the breast is found more often in married women or those previously married than in unmarried women, i.e., unmarried patients 19 per cent, married 81 per cent of the total number of

cases. In 563 cases of Schreiner, 84 patients were unmarried (15 per cent), while 479 patients were married (85 per cent). Just what is the significance of these findings in relation to the etiology of mammary cancer, I am unable to say. In this connection there are many factors. It is natural to suppose after examination of the incidence that lactation and pregnancy, also trauma from breast feeding, have something to do with mammary cancer. Lee (7) believes that prior lactation is not an important factor in the development of mammary cancer.

TABLE III—RACIAL INCIDENCE

| | Cases | | Cases |
|---------------|-------|-------------|-------|
| United States | | English | 4 |
| White | 44 | French | 2 |
| Colored | 2 | Scotch | 2 |
| Irish | 19 | Canadian | 1 |
| Italian | 14 | Mexican | 1 |
| German | 8 | Porto Rican | 1 |
| Russian | 5 | Turkish | 1 |
| Austrian | 4 | | |
| | | | 108 |

There is nothing conclusive as to the racial incidence of cancer of the breast in this series (Table III). First, the series is too limited in number. Second, the United States group is too wide in its scope, it being a composite of many races. But one is impressed by the infrequent occurrence of carcinoma of the breast in colored women.

Cancer of the breast is especially prevalent in the decades 40 to 60 years. More than one half of the cases had cancer between these years. The youngest patient was 26, while the oldest was 70 years of age.

TABLE IV—AGE INCIDENCE

| Age in years | Cases | Per cent |
|--------------|-------|----------|
| 20-30 | 4 | 3 |
| 30-40 | 19 | 18 |
| 40-50 | 33 | 30 |
| 50-60 | 32 | 30 |
| 60-70 | 20 | 19 |
| Total | 108 | 100 |

In Schreiner's series 58 per cent of all the cases occurred between the ages of 40 and 60 years. The statistics of Moschowitz showed that 113 cases (51 per cent) occurred between the ages of 40 and

60 years in a total of 218 cases Judd had 285 cases (43 per cent) between the years 40 and 60 in his series of 651 cases

TABLE V—SITUATION OF THE TUMOR

| | Cases | Per cent |
|--------------|-------|----------|
| Right breast | 36 | 52 |
| Left breast | 49 | 46 |
| Bilateral | 3 | 2 |
| Total | 108 | 100 |

Schreiner's figures

| | | |
|--------------|-----|-----|
| Right breast | 244 | 45 |
| Left breast | 275 | 49 |
| Both breasts | 34 | 6 |
| Total | 553 | 100 |

The chances of involvement of one breast or the other are about equal

Ewing states in his book that there is a slight preponderance in the left breast. The location of the tumor was present in the right breast in 102 cases (47 per cent) and in the left breast in 116 cases (53 per cent) (Moschcowitz)

Finney writes that the tumor appears with about equal frequency in the breasts, although in individual clinics one or the other breast may show a preponderance. The cases which had bilateral involvement, save one, did not present themselves as such, but rather, the cancer appeared in the remaining breast some time after radical amputation had been performed

CASE A. Both breasts were involved. In addition there were extensive metastases to the neck and lungs. Biopsy was performed and diagnosis of carcinoma was established. The patient died 11 months later.

CASE B. The left breast was involved for which a radical amputation was performed. Three years later the right breast became involved and a radical amputation of the right breast was performed. The patient died 4 years later.

CASE C. The right breast was the primary seat of the cancerous process. A radical amputation of this breast was done. Nine years later the patient was re-admitted with the diagnosis of cancer of left breast and a radical amputation was performed. She died 19 months later.

TABLE VI—EXTENT OF DISEASE

| | Cases | Per cent |
|------------------------------|-------|----------|
| Metastases to lymph nodes | 61 | 63 |
| No metastases to lymph nodes | 27 | 25 |
| Not mentioned in report | 8 | 9 |
| Total | 96 | 100 |

Moschcowitz's cases

| | |
|--------------------------|-----|
| Lymph nodes involved | 56 |
| Lymph nodes not involved | 35 |
| Not mentioned | 9 |
| Total | 100 |

The extent of the disease was determined from the pathological report. Clinical evidence of me-

tastases to the nodes was often lacking, although later checking up with the microscope revealed involvement of the nodes. The cases in which there was involvement of the nodes greatly outnumbered those in which the breast alone was diseased.

This may mean that the nodes have been involved early so that when the patient becomes aware of the primary growth and seeks medical advice, metastases have long since appeared. Of course, the finding of a lump in the breast is often accidental. The history of noticing a lump for the first time while bathing is common enough. Education has a rôle in this connection. To teach the laity the significance and the potential dangers of a tumor in the breast would mean, in many cases, an early visit to a physician. To be sure more benign tumors, as well as malignant tumors, would be seen. In fact, tumors of the breast which do not exist would be the center of attention of some patients. In these cases a careful physical examination and reassurance would suffice. In other cases an early recognition of the process would mean early treatment, and it is only through early treatment that we can hope for the best and lasting results.

Not 25 per cent of women with cancer of the breast obtain surgical treatment before their disease has gotten beyond the first stage. Sir George Newman in his preface to the present work says: "It is not because the disease advances rapidly. The prime need in reducing mortality is not extended hospital accommodations, nor improved methods of treatment nor even diagnosis. It is a *question of delay*. The essence of the situation is to assure that cancer of the breast is recognized immediately and is immediately treated" (2).

TABLE VII—PATHOLOGY

| | Cases | Per cent |
|------------------------------|-------|----------|
| Cancer (type not stated) | 30 | 31 |
| Scirrhous carcinoma | 26 | 27 |
| Carcinoma simplex | 11 | 12 |
| Fibrocarcinoma | 9 | 10 |
| Cellular carcinoma | 4 | 4 |
| Duct carcinoma | 3 | 3 |
| Gelatinous carcinoma | 3 | 3 |
| Medullary carcinoma | 3 | 3 |
| Alveolar carcinoma | 2 | 2 |
| Adenocarcinoma | 1 | 1 |
| Papillary cystadenocarcinoma | 4 | 4 |
| Total | 96 | 100 |

White noted that the proportion of private patients without axillary metastases is much greater than in the ward cases.

An arbitrary standard was set designating the size of the growth. A tumor measuring up to 3 centimeters in diameter was considered small,

up to 8 centimeters large. There were 34 cases (31 per cent) of small tumors and 74 cases (69 per cent) of large tumors.

TABLE VIII—CLINICAL CLASSIFICATION

| | Cases | Per cent |
|----------------------|-------|----------|
| Primary operable | 92 | 85 |
| Primary inoperable | 12 | 11 |
| Recurrent operable | 1 | 1 |
| Recurrent inoperable | 3 | 3 |
| Total | 108 | 100 |

The classification used is according to Lee (7, 8, 9).

Primary operable. A tumor in the breast which is not fixed to the chest wall, and is with or without axillary nodes, is operable.

Primary inoperable. One or more of the following factors are present: (1) fixation of breast tumor itself to chest wall (with fixed axillary nodes), (2) supraclavicular nodes involvement, (3) involvement of opposite axillary nodes, (4) distant metastases to chest and bones, (5) diffuse subcutaneous nodules, (6) diffuse inflammatory cancer involving a considerable skin area, (7) chest metastases pleural or mediastinal, and (8) remote metastases.

Recurrent operable. One or two small, accessible, isolated nodules as local recurrences found after former operation, with or without involvement of the axillary nodes.

Recurrent inoperable. The recurrent inoperable cases include (1) recurrent diffuse subcutaneous nodules in the operative field, (2) single fixed recurrence to chest wall, (3) the presence of axillary nodes in the same side with extension well up beneath the clavicle, (4) well marked fullness of supraclavicular fossa of the involved side with or without palpable nodes, (5) involved nodes present in opposite axilla, (6) evidence of involvement of opposite breast, (7) intrathoracic metastases, (8) any recurrence that follows operation on an inflammatory cancer of the breast, (9) metastases to bone, and (10) metastases to distant organs.

TABLE IX—TYPE OF OPERATION

| | Cases | Per cent |
|-------------------------------|-------|----------|
| Radical amputation | 89 | 93 |
| Incomplete radical amputation | 1 | 1 |
| Local excision | 6 | 5 |
| Palliative mastectomy | 1 | 1 |
| Total operative cases | 97 | 100 |
| No operations | 11 | |
| Grand total | 108 | |

The cases were treated individually. A radical amputation (Halsted, Willy Meyer) was the

method of choice with a wide excision of tumor, with axillary dissection and removal *en masse*.

TABLE X—METASTASIS

| | Cases | Per cent |
|---------------------------|-------|----------|
| Chest | 15 | 24 |
| Spine | 9 | 14 |
| Local recurrence | 8 | 12 |
| Stomach | 6 | 9 |
| Axillary | 5 | 8 |
| Liver | 5 | 8 |
| Bones other than spine | 4 | 7 |
| Abdomen | 4 | 7 |
| Nodes of neck | 4 | 7 |
| Distant skin metastases | 2 | 3 |
| Brain | 1 | 1 |
| No evidence of metastases | 63 | 100 |
| Total | 14 | |
| | 77 | |

There was definite information concerning presence or absence of recurrences in 77 of the cases. For the 31 other cases no data could be obtained on this point.

It is a well known fact that metastasis to bone is a common occurrence in cancer of the breast. The metastases to the chest, spine, and long bones of the body were 45 per cent of all the metastases found in this series. Schreiner found that recurrence followed surgical operations regardless of whether they were complete or incomplete. In one-third of the 9 known instances of recurrences in Delbet's series of 15 cases of cancer of the breast metastases occurred in the pleura and lungs. Bendick advocates taking two roentgenograms, a pelvic roentgenogram and a chest roentgenogram. On a single 14 by 17 inch film one can get the lumbar spine, pelvic bones, and both hips. It would seem wise to roentgenograph not only the chest but also the spine, pelvis, and long bones as a pre-operative routine measure. White says that he takes roentgenograms of the chest, spine, and pelvis before operation, but he adds that the roentgenogram does not necessarily reveal the early bone metastases. However, it is a practice that should be carried out. An occasional positive finding would justify this measure.

END RESULTS IN THIS SERIES

Since this was to be a statistical study, I decided to determine first the end results of all the cases just as they came without fixing a 5 year period following operation to record the number of the "cured" cases. Our follow-up system was started in February, 1913. Of the 107 cases that were followed up, 94 cases were seen at the clinic or heard from through letters or nurses. A report

was made of the date of death, the cause of death in some cases, and the condition of the patient when last seen. The system showed an 87 per cent efficiency.

TABLE XI—END RESULTS

| | Cases | Per cent |
|---------------------------------|-------|----------|
| Death or result after operation | | |
| First 6 months after operation | 18 | 19 |
| 1 year after operation | 21 | 22 |
| 2 years after operation | 13 | 13 |
| 3 years after operation | 11 | 12 |
| 4 years after operation | 5 | 5 |
| 5 years after operation | 6 | 6 |
| 7 years after operation | 2 | 2 |
| 8 years after operation | 1 | 1 |
| 12 years after operation | 2 | 2 |
| Living { alive and well | 10 | 10 |
| { alive with recurrences | 7 | 8 |
| No trace | 11 | — |
| Total | 107 | 100 |

Lost track of 12 patients
 6 months after operation 3
 1 year after operation 4
 2 years after operation 2
 3 years after operation 1
 4 years after operation 1

Total

11

Three patients died of intercurrent diseases, one of heart trouble, another of paralytic stroke, an other of pulmonary embolus. The cause of death in the other cases was due to cancer so far as we can tell.

A 5 year limit following operation was next considered. There were 84 cases in all which had a 5 year or more postoperative period. Analysis of this group is shown in Table XI A.

TABLE XI A—FIVE YEAR RESULTS

| | Cases | Per cent |
|----------|-------|----------|
| Living | 7 | 9 |
| Dead | 65 | 91 |
| No trace | 12 | — |
| Total | 84 | 100 |

Twelve cases were placed under "No trace" heading following Lee (10) that patients dying from intercurrent disease before the expiration of 5 years but without evidence of cancer have been excluded from statistical study as well as those who have been completely lost track of.

There were only 9 per cent of the cases in this group living and well 5 years after operation. This figure is lower than one generally thinks of in connection with "cures" for mammary cancer.

CLINICAL INDEX OF MALIGNANCY

Recently Lee (11) graded 100 primary operable cases of cancer of the breast from clinical data alone to determine if such data would give an accurate estimate of the degree of malignancy. We considered the age of the patient, the presence or absence of lactation, the rate of growth of the tumor, and the extent of the disease so called weighting factors (Table XII A).

TABLE XII A—WEIGHTING FACTORS

| | |
|-------------------|-------|
| Age | A = 2 |
| Lactation | L = 3 |
| Rate of growth | R = 4 |
| Extent of disease | E = 5 |

The weighting factors were subdivided and evaluated and these subdivisions were known as gradation factors (Table XII B).

TABLE XII B—GRADATION FACTORS

| | Weighting factors | Gradation factors |
|-------------------|-------------------|-----------------------------------------------------------------|
| Age | A = 2 | Lo { Over 55 = 1 41-55 = 2 40 or under = 5 |
| Lactation | L = 3 | Lo { Absent = 0 Present = 3 |
| Rate of growth | R = 4 | Ro { Slow = 1 Moderate = 2 Rapid = 4 |
| Extent of disease | E = 5 | Lo { Small (5 cm or less) = 1 Large = 2 Nodes present = 4 |

The clinical index of malignancy for any individual was then calculated by multiplying the value of each weighting factor by its gradation factor and adding the results as: Clinical index of malignancy = $2A_0 + 3L_0 + 4R_0 + 5E_0$. A patient of 57 years of age having a small tumor which has been growing over a number of years would be placed in Grade A as—clinical index of malignancy = $2 \times 1 + 3 \times 40 + 1 \times 1 + 5 \times 1 = 11$ —whereas a young woman 28 years of age with a rapidly growing tumor and with involvement of axillary nodes would be placed in Grade C as clinical index of malignancy = $2 \times 5 + 3 \times 0 + 4 \times 4 + 5 \times 4 = 46$. Based on such calculations patients were placed into one of the three grades.

Grade A 11-25 relatively benign
 Grade B 26-39 Moderately malignant
 Grade C 40-55 highly malignant

The results obtained in the series were as follows.

Grade A—relatively benign—69 per cent of patients were alive and well, 5 years or more,

Grade B—moderately malignant—34 per cent of patients were alive and well, 5 years or more,

Grade C—highly malignant—4 per cent of patients were alive and well, 5 years or more

Thus a reasonably accurate prognosis can be given by the use of the clinical index of malignancy

Next we considered whether the clinical or histological grading would furnish a more accurate prognosis Dr Ewing graded these same cases as

Grade 1—relatively benign—52 per cent were alive and well 5 years or more,

Grade 2—moderately malignant—33 per cent were alive and well, 5 years or more,

Grade 3—highly malignant—20 per cent were alive and well, 5 years or more—

thereby showing that the clinical grading made a more accurate selection of the patient than did the histological grading and gave a more accurate prognosis

Believing it would be interesting to find out whether or not similar results would be obtained in a survey of another group of cases, I analyzed the same series in the same way There were 65 appropriate primary operable cases and the clinical index of malignancy was calculated in each case The results are shown in Table XIII

TABLE XIII—CLINICAL GRADING

| Grade A* | Relatively benign | No of Patients | Per centage |
|----------------|----------------------|----------------|-------------|
| Alive and well | 5 years or more | 3 | 19 |
| Dead within | 1 year | 3 | 19 |
| | 2 years | 4 | 25 |
| | 3 years | 1 | 6 |
| | 4 years | 1 | 6 |
| | 5 years | 4 | 25 |
| Grade B | Moderately malignant | | |
| Alive and well | 5 years or more | 1 | 2 |
| Dead within | 1 year | 9 | 24 |
| | 2 years | 11 | 29 |
| | 3 years | 7 | 19 |
| | 4 years | 3 | 8 |
| | 5 years | 6 | 18 |
| Grade C | Highly malignant | | |
| Alive and well | 5 years or more | 1 | 8 |
| Dead within | 1 year | 5 | 42 |
| | 2 years | 1 | 8 |
| | 3 years | 4 | 34 |
| | 4 years | | |
| | 5 years | 1 | 8 |

*The 3 cases mentioned above dying from intercurrent disease fell in Group A thus tending toward a higher mortality rate for this group

Grade A—relatively benign—19 per cent of patients were alive and well 5 years or more

Grade B—moderately malignant—2 per cent of patients were alive and well, 5 years or more

Grade C—highly malignant—8 per cent of patients were alive and well, 5 years or more

A similar histological classification was done Table XIV shows Dr Lawrence W Smith's gradation of these same cases

TABLE XIV—HISTOLOGICAL GRADING

| Grade 1 | Relatively benign | No of patients | Per centage |
|----------------|----------------------|----------------|-------------|
| Alive and well | 1 year | | |
| Dead within | 2 years | 1 | 100 |
| | 3 years | | |
| | 4 years | | |
| | 5 years | | |
| Grade 2 | Moderately malignant | | |
| Alive and well | | 3 | 18 |
| Dead within | 1 year | 3 | 18 |
| | 2 years | 4 | 23 |
| | 3 years | 2 | 12 |
| | 4 years | 1 | 6 |
| | 5 years | 4 | 23 |
| Grade 3 | Highly malignant | | |
| Alive and well | | 2 | 4 |
| Dead within | 1 year | 16 | 34 |
| | 2 years | 9 | 20 |
| | 3 years | 8 | 17 |
| | 4 years | 4 | 8 |
| | 5 years | 8 | 17 |

Grade 1—relatively benign—0 per cent were alive and well 5 years or more

Grade 2—moderately malignant—18 per cent were alive and well 5 years or more

Grade 3—highly malignant—4 per cent were alive and well 5 years or more

A comparative analysis of the clinical and the histological grading is given in Table XV

TABLE XV

| Grade A | Alive and well | Dead within |
|----------------|----------------|-------------------|
| | yr | 1 2 3 4 5 yrs yrs |
| Grade 1 | 3 | |
| Dead within | 1 year | 3 |
| | 2 years | 4 |
| | 3 years | 1 |
| | 4 years | 1 |
| | 5 years | 4 |
| Grade B | | |
| Alive and well | 1 | |
| Dead within | 1 year | 10 |
| | 2 years | 11 |
| | 3 years | 7 |
| | 4 years | 3 |
| | 5 years | 7 |
| Grade C | | |
| Alive and well | 1 | |
| Dead within | 1 year | 5 |
| | 2 years | 1 |
| | 3 years | 4 |
| | 4 years | 1 |
| | 5 years | 1 |

Although these results are very different from those obtained by Lee yet again a clinical

grading makes a more accurate selection of the patient than did the histological grading and gives a more accurate prognosis

CONCLUSIONS

1 That there were very few cases of cancer of the breast treated on this general surgical service

2 Mammary cancer is found more often in married women than in unmarried women, to such an extent that one suspects that the incidence of mammary cancer in married women is dependent on some definite factor

3 Patients coming to the hospital for treatment show a great predominance of already involved axillary nodes Education and avoidance of delay after a tumor of the breast has been discovered would help to bring about better subsequent results

4 The incidence of bony metastases is so high as to warrant pre-operative X ray of chest, pelvis, and spine as a routine measure

5 The end results in this series are very discouraging Only 9 per cent of the cases are living after a period of 5 years following operation

6 A clinical grading of cancer of the breast makes a more accurate selection of the patient than does a histological grading and gives a more accurate prognosis

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VESICAL NECK OBSTRUCTION

WITH PRESENTATION OF A NEW INSTRUMENT FOR ITS RELIEF

THOMAS J. KIRWIN, M.D., M.A., M.S., F.A.C.S., NEW YORK

From the James Buchanan Brady Foundation of Urology New York Hospital New York

THE ideal of all surgery is the preservation of anatomical parts in normal relation. The degree of attainment of this ideal must be consistent with relief of the patient. But to remove ruthlessly by surgical intervention all tissues in pathological condition, is the course taken only by those who are prone to follow the line of least resistance. The principal points to be considered in conservative surgery are first, relief of whatever pathological condition is present, second, conservation, with consideration of future prognosis, third, fulfilment of the two conditions just named with the utmost safety to the patient.

It has been my aim, in considering the problem of the removal of median bar obstruction, to design an instrument making possible the complete adherence to these three major surgical principles, and at the same time relieving the condition without resort to Herculean procedures often dangerous or even fatal. Before describing this instrument, I wish briefly to mention some of the methods previously used to relieve this obstruction.

These may be divided into three classes: (1) those employing the suprapubic route, (2) those necessitating blind removal *per urethram*, (3) those providing for removal under direct vision, but equipped with electric cauterizing devices which do not provide for accurate determination of the amount of cauterization. Various instruments designed to excise the bar, but without proper consideration for provision against post-operative hemorrhage.

HISTORICAL SURVEY

When Wellington undertook the Peninsular Campaign his troops were accompanied by a young military surgeon named George James Guthrie. I use the word *young* advisedly, for Guthrie was born in 1785 and the Peninsular Campaign began in 1807. More than that Guthrie had been a certified army surgeon for 6 years previously, having passed his examinations and been assigned to a regiment when little more than 16. His military career lasted until after the final fall of Napoleon. Beginning as he did at such an early age, Guthrie's opportunity for observing the various pathological conditions to which the

male urinary apparatus may be subject was exceptionally wide. This is attested by his book, *Anatomy and Diseases of the Urinary and Sexual Organs*, which was published after he began private practice. In this volume he arrives at the conclusion "that an elastic structure exists at the neck of the bladder and may be diseased without necessary connection with the prostate gland." Likewise "the prostate gland may be diseased without any necessary connection with the elastic structure." This appears to be the first recognition of what has come to be known as median bar obstruction at the vesical neck.

At the time it was published no particular attention was paid to Guthrie's observation, so that when a dozen years later a similar idea was promulgated in France it was hailed as quite original. Indeed, any connection of Guthrie's would hardly have been revived at all, had he not been cited by Civiale, the French urologist, in reply to his confrere Mercier's accusation that Civiale's writings on the subject of median bar obstruction had been plagiarized from his own. Even then Civiale designated him as "some English surgeon," without mentioning his name. There appears to be little doubt that Civiale's contribution was made prior to that of Mercier despite that choleric individual's furious outcry to the contrary. In his *Traité pratique sur les Maladies des Organes génito-urinaires* he states that he has made use of "le trépan et le lithoclaste à ecrou" since 1824. "These instruments," he tells us, "are introduced into the bladder, where they are opened in such a manner as to give the vesical extremity a volume proportionate to the dilatation it is desired to produce. The instruments are then withdrawn dilating the tract along which they pass, from behind forward. Should it be desired to effect further dilatation at the same sitting, they should be closed when they have been pulled back as far as the membranous urethra, then reintroduced into the bladder, thereafter to be withdrawn in the same manner as before. The surgeon should never lose sight of the fact that this is decidedly heroic treatment, the abuse of which may lead to the gravest consequences, the maneuver should be carried out with the greatest care and prudence."

grading makes a more accurate selection of the patient than did the histological grading and gives a more accurate prognosis

CONCLUSIONS

1 That there were very few cases of cancer of the breast treated on this general surgical service

2 Mammary cancer is found more often in married women than in unmarried women, to such an extent that one suspects that the incidence of mammary cancer in married women is dependent on some definite factor

3 Patients coming to the hospital for treatment show a great predominance of already involved axillary nodes. Education and avoidance of delay after a tumor of the breast has been discovered would help to bring about better subsequent results

4 The incidence of bony metastases is so high as to warrant pre-operative X-ray of chest, pelvis, and spine as a routine measure

5 The end results in this series are very discouraging. Only 9 per cent of the cases are living after a period of 5 years following operation

6 A clinical grading of cancer of the breast makes a more accurate selection of the patient than does a histological grading and gives a more accurate prognosis

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A controversy—largely of Mercier's making—was waged for a number of years between the two French urologists as to the priority in the investigation of the nature of median bar obstruction at the vesical outlet, and originality in the design of instruments for its relief. But Mercier, after the fashion of the Pharisees, succeeded by his "much speaking" in getting the entire credit for this important contribution to urology, even today the condition concerned is most frequently referred to as Mercier's bar. In 1850, the Académie Française des Sciences awarded Mercier a prize of 1,500 francs, crediting him among other things with having "perfected the construction of instruments, easy of handling, by aid of which one incises, or with the same, excises the valve, in a manner to produce a more certain and prompt cure."

If Mercier really did add anything to what Guthrie had already set forth in his writings and lectures it was not of sufficient interest to the practitioners of his time to keep the subject actively before them. We hear little more about median bar obstruction at the vesical outlet until the perfection of the cystoscope immeasurably increased the possibilities of urologic examination. Even then, so much more attention was paid to hypertrophy of the prostate and the pathology induced by its existence that the symptoms of median bar hypertrophy were confused or entirely overlooked. The *prostatisme sans prostate* of the French school of which Guyon was the leader during the last decade of the nineteenth century was a vague conception, blaming vesical obstruction in the absence of prostatic lobe enlargement upon muscular changes in the bladder wall induced by arteriosclerosis. It was not until 1901 that Charles H. Chetwood collected the various designations for the condition at that time prevalent, and suggested that in their place should be used a single name *originating with the elder Keves—that is, contracture of the neck of the bladder*.

A few years later—in 1905—Chetwood again called attention to the subject and put forth

what may justly be termed the first modern conception of median bar hypertrophy and its rational treatment. Contracture of the bladder neck, he pointed out, is a common cause of vesical obstruction, its relief is safe and sure by means of a galvano prostatectomy through a perineal opening, it is often an explanation for what has been termed "prostatism without enlargement of the prostate."

The idea of using the cautery to remove obstruction at the vesical outlet was by no means a new one when Chetwood wrote. As far back as 1877 the Italian surgeon, Bottini, had suggested such a possibility and perfected an instrument which from time to time he called to the attention of the practitioners of urology. In 1900, Albert Freudenberg of Berlin, described before the Thirtieth International Congress of Medicine convened at Paris, his employment of Bottini's procedure for the relief of prostatic hypertrophy, together with the instrument he had designed for this purpose, which he called a cystoscopic prostatic incisor. While it was patterned after Bottini's cautery, the cystoscopic features are apparently original with Freudenberg. So to him should be accorded the credit for creating the design which has since seen so many improvements and modifications at the hands of later surgeons.

During the next 20 years many minds were centered upon the development of instruments of this type and substantial progress was made. Minor alterations were made by Wossidlo and Goldschmidt in Europe while in this country revolutionary changes were inaugurated by Hugh Hampton Young, who first showed his instrument and reported his early cases before the Second International Congress of Urology in 1911, at Paris. Young's instrument is the prevailing type in use at present. All others are but modifications of one or another of its basic features. He has himself made substantial changes in it from time to time.

With a view to meeting the special problem offered by obstruction in the urethra, Maximilian

Fig. 1. Showing anomalous variations in the genitovesical arteries in the male subject. The genitovesical artery—properly so called—bifurcates into the anterior hemorrhoidal *H* and the prostatic *P*. The first is well placed to supply its anterior vesical branch, as well as those going to the fat and the retrosymphic region before leaving the pelvis. The prostatic—after giving off a small branch to the seminal vesicle—is wholly devoted to the prostate, ending in a long inferior anterior branch to the bladder. It is the umbilical *O* which, together with the deferential, *d*, arising directly from the hypogastric supplements the deficiencies of the genitovesical.

Among the branches of the posterior umbilico vesical

destined for the subperitoneal layer of the bladder, the most posterior reaches the termination of the ureter in the trigone where it gives off a recurrent twig which detaches itself from an inferior vesical branch which in turn is carried forward by a large veviculodeferential branch, this being an offshoot of this same posterior umbilico vesical artery.

The 12 arterial branches ramify over both surfaces of the seminal vesicle, one advances to the ampullary portion of the vas deferens where it anastomoses with a descending branch of the autonomous deferential *d* which might very well be designated as the deferential uterine. (After Larabœuf)

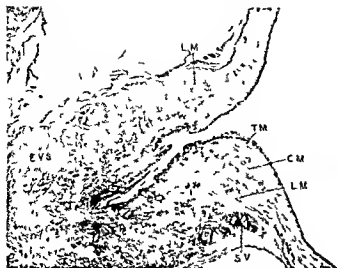


Fig 4 Cross section of a 21 mm human embryo Ureters enter on dorsal surface of bladder (cloaca), not at lateral edge (Courtesy of Dr M B Wesson)

Stern, of New York, in 1919 modified the Gerlinger operating cystoscope. The Caulk cautery punch, given to the medical profession in 1921, is merely the combination of a cautery device with the Young punch. McCarthy's panendoscope was a most important contribution to the assemblage of urological instruments. His telescopic system has been embodied in numerous devices since it was first designed. It also embodies a cautery feature which was modified by Collings in 1926, the resulting device being called the electrome. Rose's cautery punch was made available in 1928. Still another contributor was F E B Foley, of St Paul. The most recent modification of which I have knowledge is that of Day, of Los Angeles which is also founded on McCarthy's work. Others who have worked on this problem are Beer, Stevens, Bugbee, Braasch and Bumpus of the Mayo Clinic, Geraghty, and Mathe.

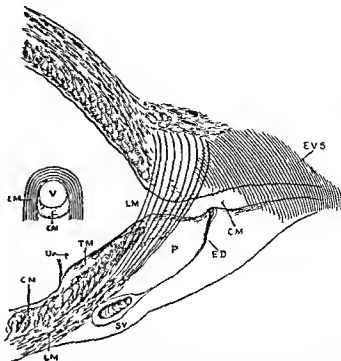


Fig 5 Sagittal section of adult bladder (diagrammatic) "The external longitudinal layer of the base sweeps up over the vesical orifice making a loop. Within this loop the circular layer forms a wedge below the orifice and flows down the urethra in an oblique direction surrounding the canal as a thin layer. The result is a double loop and not a sphincter. The small insert is a cross section of the vesical orifice showing the upward pull of the loop from the circular muscle and the opposing action of the longitudinal muscle loop. 1, vesical orifice, LM, longitudinal muscle, CM, circular muscle, TM, trigonal muscle, EVS, external vesical sphincter (striated muscle), U, urethral orifice, SV, seminal vesicle, ED, ejaculatory duct, P, prostate" (Courtesy of H H Young and M B Wesson)

ANATOMY AND PHYSIOLOGY OF BLADDER NECK

In order to have any proper understanding of the pathology of median bar obstruction, or to be able to realize the significance of certain changes seen during clinical practice, one must be thoroughly familiar with the anatomy and

Fig 2 The bladder after the removal of three-quarters of its antero inferior surface, it is dislocated considerably downward and outward. The blood vessels, as well as the pelvic portion of the ureter have thus, to a certain extent, lost their normal anatomical relations. The right pubo vesical ligament is greatly stretched. 1, Epigastric artery, 2, umbilical artery, 3, obturator artery (seen by transparency), 4, trunk of the superior vesical arteries, 5, genito vesical artery, 6, vesiculodeferential artery, 7, gluteal artery, 8, anterosuperior vesical artery, 9, posterosuperior vesical artery, 10, ascending anterior vesical artery, 11, inferior vesical artery, 12, obturator artery (seen by transparency) of anomalous origin, 13, prostatic artery, 14, umbilical artery, 15, anterosuperior vesical artery, 16, posterosuperior vesical artery, 17, inferior vesical artery, 18, vesical branch of the genitovesical artery, 19, vesical branch of deferential artery, 20, vesicular artery, 21, def-

erential artery, 22, middle hemorrhoidal artery, 23, inferior vesical veins, 24, genitovesical artery, 25, vesiculodeferential artery (After Tsaknis)

Fig 3 The bladder after section of the lateral attachments and the pubovesical ligaments it is drawn sharply forward so as to display Santorini's plexus. 1, epigastric artery, 2, umbilical artery, 3, obturator artery, showing abnormal origin of the gluteal, 4, anterosuperior vesical artery, 5, posterosuperior vesical artery, 6, lateral veins of the bladder, 7, superior vesical trunk, 8, gluteal artery, 9, superior layer of the middle aponeurosis, 10, ascending anterior vesical artery, 11, obturator artery, 12, umbilical artery, 13, anterosuperior vesical artery, 14, posterosuperior vesical artery, 15, inferior vesical veins, 16, inferior vesical veins, 17, genitovesical veins, 18, vesiculodeferential artery (After Tsaknis)



Fig. 2

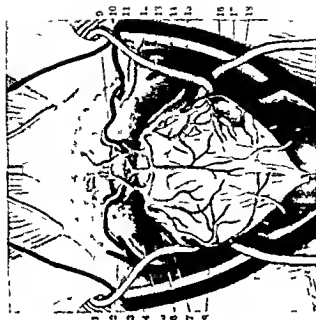


Fig. 3

Vesical Neck Obstruction—Thomas J. Kiran

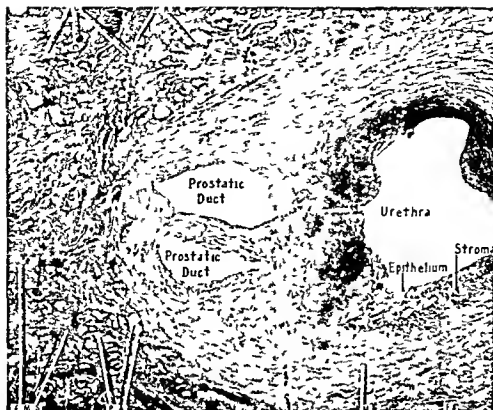


Fig 7 Section through urethra and portion of prostate gland C, Concretions in alveoli, P 1, prostatic alveoli F M S, fibromuscular stroma M, muscularis F, fibrosa

Therefore, to the meager information to be found in anatomical and urologic textbooks, it will not be out of place to add the following

Vesical arteries All the arteries supplying the bladder have their origin in the hypogastric, though their point of origin varies so much in individuals that it is impossible to lay down any rules. As their course is almost equally variable, it is necessary to exercise great caution before severing any of them, and the wisest plan usually proves to be that of tracing each one to its starting point, though this in many cases will, of course, be quite out of the question. When the arteries have reached the bladder they are subdivided into multiple branches which are customarily distinguished as anterior, superior, posterior, and inferior. These form a plexus from which are given off many tiny arterioles which penetrate the bladder musculature and course through the mucosa, eventually forming another plexus in the submucosa.

The genitovesical artery—so called by Farabeuf—often takes off from the hypogastric in a common trunk with the prostatic artery. It is accompanied by several satellite veins in the first part of its course, but as it nears the lower part, at its crossing of the vas deferens where it is nor-

mally separated from the prostatic artery, it becomes so enmeshed in vesical veins that it is at times hard to trace out its arterial branches without actually dissecting them. Arteries, veins, and nerves surround the urethral orifice and the upper third of the urethra, forming what Tsaknis terms the *urethrovascular pedicle*. The artery approaches the bladder at the same angle as the ureter, but before it gains the ureter's point of entrance through the bladder wall it divides into several branches which pass forward and below so as to surround the ureter. If any of these branches chance to approach the bladder at the lower part of its lateral border it is exceptional, and apparently they almost never reach the middle region of its inferior edge. But once the branches have attained the bladder wall they are distributed with fair regularity to the base, the vesical neck, the lower part of the lateral walls, and some to the antero-inferior and posterosuperior walls. A few fine ramifications even reach the seminal vesicles and the prostatic urethra, as well as the prostate itself. The genitovesical artery anastomoses at base of bladder with some branches from the prostatic artery.

In general, it is the inferior arteries which supply the bladder neck and the trigonal region

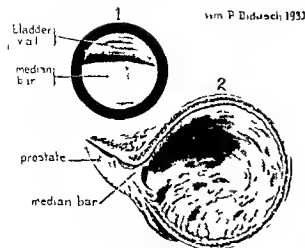


Fig. 8. Type 1 vesical neck obstruction: median bar of dense sclerotic tissue directly across posterior lip of orifice.

They are branches of the genitovesical anastomosing with offshoots of other vesicular arteries and the hæmorrhoidal branches. Sometimes branches of the vesiculodeferential are directed toward the base of the bladder.

Veins of the vesical neck. The French writers designate the veins by the same titles as those which they apply to the arteries. It is the group called *postero inferior* made up of the veins which accompany the arteries covering the postero-superior surface of the bladder, which supply vessels to the neck of the bladder and the trigonal region. The veins of the posterosuperior bladder wall are visible as soon as the peritoneum is exposed; they all take a downward course but frequently diverge considerably as they descend so as to run off at quite acute angles. At either side they anastomose with the group of lateral veins and those from the vesical plexus. Most of them eventually reach the lower wall of the bladder, thence arrive at the seminal plexus, while a few are likely to be found in front contributing to the formation of the inferior vesical veins. The veins which arise at the trigone and bladder neck flow into the lower stratum of the allantoid sheath taking a forward and upward course to empty into the seminal plexus in front and into the vesical plexus behind.

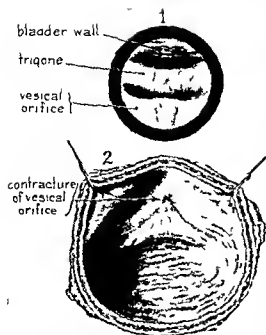
As we approach the vesical neck while making an examination of the blood vessels of the bladder wall it is noticeable that their number and size increase the nearer we approach the trigone. It was observed by Keiffer that those close to the vesical neck became lacunar and cavernous in character, and that the conjunctive tissue below the mucosa was also very rich in

vessels. The peculiar richness of the blood supply of this region led him to believe that the phenomenon of micturition is largely brought about by changes in blood pressure, rather than by nerve influences, as is the more common conception.

PATHOLOGY OF VESICAL NECK OBSTRUCTION

Turning now to a consideration of the pathology of median bar hypertrophy we find that this subject has occupied the attention of some of the foremost urologists in this country. Our modern conceptions in regard to it are practically all the result of the work of American investigators, chief among them being H. H. Young and Alexander Randall. Randall studied 28 cases of median bar formation found in the course of 200 routine autopsies. Eight of these bars were very pronounced but the remainder, though microscopically observable, were early cases in which the bar had not enlarged sufficiently to cause any important degree of obstruction to the outflow of urine, with its inevitable effect upon the remainder of the genito-urinary tract. This author differentiated four types of median bar formation: (1) An abrupt bar or dam of dense sclerotic tissue directly across the posterior lip of the vesical orifice, always associated with a "small sclerotic prostate." (2) A bar growing upward rather than across, encroaching more upon the vesical trigone, so that it tends to cause a transverse fold or crease in the trigonal area. (3) A bar resulting from true glandular hypertrophy originating under the "sphincter muscle" within the prostatic capsule. Even very slight hypertrophy at this point will tend to produce a thick, broad, round edged bar causing obstruction of the vesical outlet long before the hypertrophy of the lateral lobes assumes any importance. This was the type which Randall himself had most frequently encountered. Rare examples of (4) a fourth type of bar formation may be observed. This is due to hypertrophy of the glands of Albarran without hypertrophy elsewhere. It produces, not a bar, but a rounded lobe and the author found difficulty in deciding whether such formations when discovered in the bar shape should be classed as such—that is, clinically considered—or be grouped with prostatic hypertrophies "which anatomically they are."

In Young and Wesson's 125 cases of hypertrophy of the trigone, they noted a characteristic progression in the development of the condition. The trigone was at first but little elevated above the vesical wall, while the ureteral ridges were

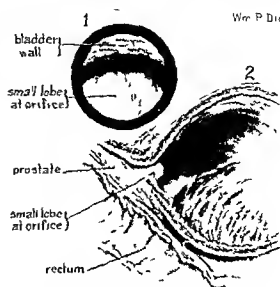


Wm P Didusch 1930

Fig 9 Type 2, vesical neck obstruction Bar forming a transverse fold in the trigonal area Note hypertrophy of trigone

very definitely raised. In the second stage the trigone had been elevated until it was level with the ureteral ridge, and a shallow cavity was in evidence behind the interureteric ligament. A third stage, wherein the median bar has assumed definite proportions, brings the trigone like a shelf close against the vesical orifice, with the interureteric ridge standing out like a cord with a slight pouch before it, and a deep pocket behind. This is the true Mercier's bar, though this name is often applied to the bar at the vesical neck. In the fourth stage hypertrophy advances much further, the deep pocket is still more profound and may even undermine the trigone so as to dissect it entirely free from the bladder wall and erect it like a dam serving to divide the vesical cavity in two. The process may go on until a large diverticulum is formed.

It should be borne in mind that all the changes which are found in the region of prostate and trigone are dependent upon the existence of inflammation—the final result of some variety of infection which has proliferated in this area at some time or other. Its etiology is, in the last analysis, similar to that of stricture of the anterior urethra. The mucosa of the vesical neck is even better supplied with glands than is that of the anterior urethra. Consequently any inflammatory process will make rapid headway if



Wm P Didusch 1930

Fig 10 Type 3 vesical neck obstruction True glandular hypertrophy, causing a small lobe at the orifice

once begun in this region. Any condition which will eventually induce prostatic hypertrophy may act in like manner upon the tissues of the vesical neck. This circumstance makes clinical differentiation between the two conditions exceptionally vexatious. We must rely wholly upon cystoscopic observation in making the diagnosis, and as treatment and prognosis are entirely different, the establishment of this distinction assumes great therapeutic importance.

INSTRUMENTS

As our historical review has shown, the attempt to design an instrument capable of dealing with hypertrophy of the median bar preceded by many years any scientific understanding of the condition with which one was attempting to deal. As to the exact nature of the *Trilobe* and *Lithoclaste à cron*, of Civiale, I am decidedly uncertain. From references in his text they would appear to have been something on the order of the evulsors or dilators still occasionally employed. The instrument originated by Bottini and modified by Freudenberg may properly be accepted as the first of this particular type to be produced. The design of Chetwood's instrument bore some resemblance to that of Bottini and Freudenberg, but it appears to have been productive of far more satisfactory results. Young's first "punch" was a curved posterior urethroscope, with an inner cutting tube, which was later replaced by a tubular cautery in an endeavor to combat the often troublesome hemorrhage. Young later referred to this early design as "satisfactory but somewhat complicated." With a view to meet-

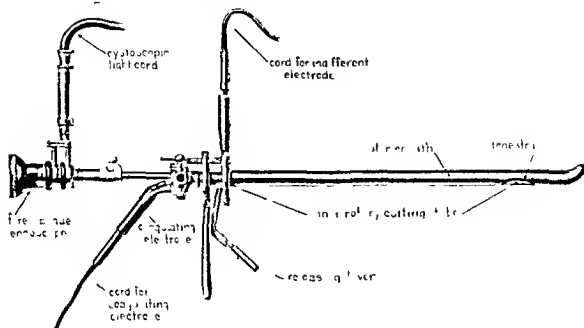


FIG. 11 The assembled instrument

ing the special problem offered by obstruction in the urethra. Maximilian Stern of New York modified the Gerninger operating cystoscope in 1919. His instrument contained a direct vision telescope, a light carrier and a cannula through which instruments might be passed. The latest addition to this group of instruments is Day's modification of the McCarthy punch recently described in the *Journal of the American Medical Association*. With this instrument, we are told, 'every advantage of the McCarthy punch is retained with the added insulated needle for preliminary electrodesiccation with a d'Arsonville current.'

The vesical neck resector. To present still another instrument when the needs in this respect have apparently been so fully met requires courage. Yet I feel that the device I am about to describe embodies certain features lacking in all the others while making it possible for the features of these previous models to attain higher efficiency than even their originators demanded of them. While making no claims to originality, I feel I have succeeded in so manipulating the various parts and supplementing their deficiencies that the completed instrument is more useful than any which have been produced before it. My modifications adapt the instrument I am presenting especially for dealing with vesical neck obstructions, that is, median lobe, prostatic

middle lobe contracted bladder neck, obstruction due to post-prostatism and subcervical gland enlargement.

Up to the present the greatest need in removing median lobe obstruction at the bladder neck appears to be a technique which will render the operation bloodless or nearly so. To accomplish this different designers have employed the actual cautery. This is a heating element consisting of a metal blade attached to conductors of electric current of very high capacity. The conducting capacity of the blade itself is low, so that it will be rendered hot as soon as a sufficiently strong current is passed. Whenever this occurs the hot blade in contact with wet tissue immediately develops steam, scalding the adjacent surfaces with subsequent scarring and contraction of the mucous membrane.

Replacing the actual cautery by instruments conveying high frequency current does not do away with this danger unless special attention be given to the technique of application. If a small area electrode be used for transmitting the current to the tissues an arc will form. The arc, being hotter than the cautery blade ever becomes, produces ionization and this has a toxic effect which is even more injurious than the scalding effect produced by the red hot cautery.

Yet as a moderate high frequency current is quite sufficient to coagulate blood, proper ad-

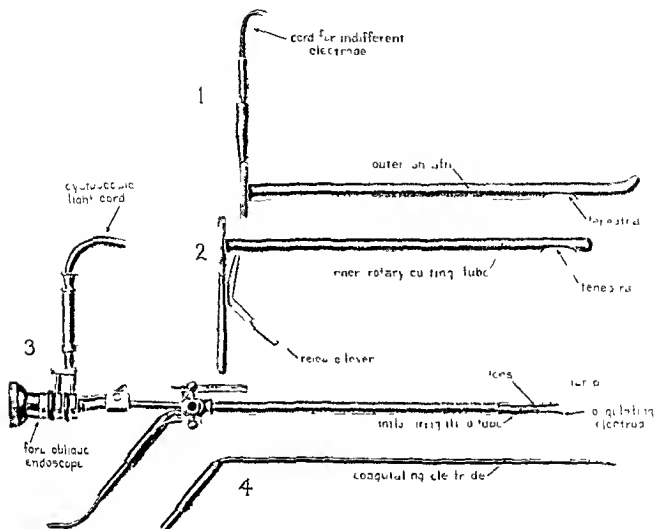


Fig. 12 Instrument dismounted, showing component parts and electric connections

justment will permit an instrument to accomplish this purpose without ever reaching the scalding point. The blanched area will be a zone of only a few millimeters' extent, directly surrounding the electrode needle. When this has been resected, the cells of the zone about the wound, though heat treated, will still be capable of regeneration and repair, and will show little or no tendency toward cicatrization.

Having in mind these facts in regard to the effect of heat, not alone in producing temporary hæmostasis, but as a source of permanent damage to adjacent tissues, I have designed an instrument for resection of the vesical neck which combines the good points of those which have preceded it, and obviates the drawbacks to which they are subject. To keep the field clear of blood, yet still enjoy freedom of movement with the instrument, the sheath must be without the wicked tooth which characterizes all punch instruments. The fenestrum must be smooth

edged and nicely rounded. Water pressure must be provided, enabling one to locate, recognize, and avoid adjacent organs and tissues. Any intruding prominence must be minutely visible. All of these requisites are provided by my instrument. Fixation of any protruding tissue is accomplished by means of a strong electric needle, which at the same time renders the piece bloodless before it is removed. A sharp edged knife is provided to cut off the piece after hæmostasis has been attained by the cautery. This makes it possible to repeat the resecting process as often as the operator wishes, so that everything can be cleared away at a single session. The McCarthy oblique lens system is employed for visualization and illumination.

My instrument consists of an outer steel sheath equipped with a fenestra on one side and a curved beak. An inner tubular structure replaces the usual obturator, which carries the McCarthy lens system, a high frequency needle, and irri-

Van P Douch 1939

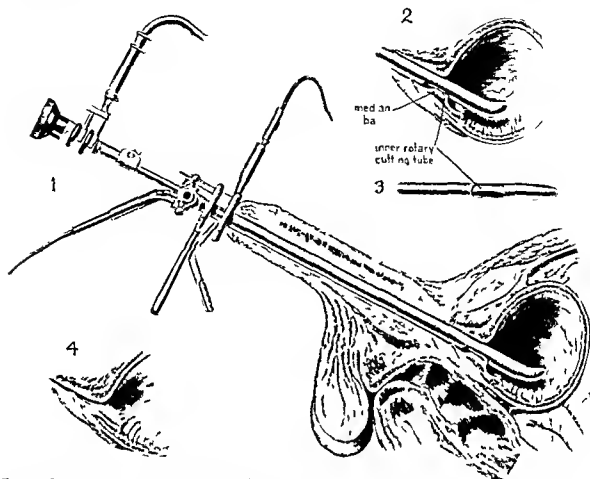


Fig. 13. Instrument in position for vesical neck resection. 1. Sheath passed through urethra into bladder. Cautery needle point fixes tissue to be removed. 2. Tissue has

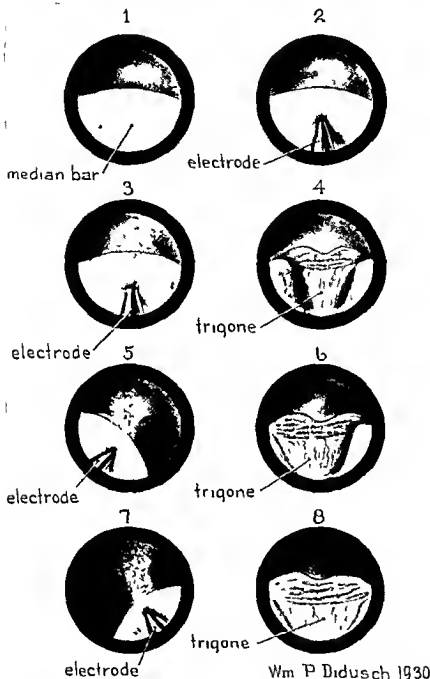
been desiccated (indicated by whitening) and is about to be cut off by 3. the inner rotary cutting tube.

gating cocks. A tubular knife between the two sheaths acts as an obturator, rotating between the two parts previously described. Especially important is this knife which rotates to the operator's right, and thus opens the fenestra. Because its edges are well rounded, the tooth usually found on prostatic punches is unnecessary and has been omitted. This eliminates trauma to the bladder neck while searching for the obstruction. Completely independent of sheath, telescope illuminator, needle, and irrigating system, the knife can be rotated at will without disturbing or twisting irrigating tubes or cords. At the same time the main instrument has the freedom of motion necessary for exact location of the tissues to be excised, the site of which the preceding cystoscopic examination has determined.

Operation with this instrument is generally done under caudal anesthesia. For operators

who do not employ this method, and for cases in which it is inadmissible for any reason, I have provided an electrode equipped as a Luer needle. With this novocain can be injected directly to the area where section is to be done.

The obstructing tissue having been located and anesthetized (if caudal anesthesia is not used) it is firmly fixed by the needle electrode and desiccated under low heat (about 30 seconds). It is then resected by rotating the tubular knife and the resected tissue withdrawn by removal of the knife and the inner tube with its attachments, leaving the outer sheath in the urethra. By pressure of the thumb lever any binding at the fenestra is overcome, as the possibility of rotation while pulling obviates jerking and trauma. The section of tissue may be removed the needle adjusted, etc., and the knife and tube reinserted for further resection as many times as is found



Wm P Didusch 1930

Fig 14 Resection of vesical neck obstruction 1 Median bar of dense sclerotic tissue 2 Needle electrode applied to center of bar 3 Desiccation of tissue indicated by whitening 4 Trigone exposed by first excision 5 Needle electrode applied at one side of bar 6 Further exposure of trigone 7 Needle electrode applied to opposite side of bar 8 Trigone in full view after three cuts have been made with rotary cutting blade following desiccation of tissue

necessary The electric needle and the sharp knife edge serve to engage the instrument firmly in the tissue, so that we actually get larger sections, while the lateral, instead of the customary longitudinal, punch also prevents the pushing out of the greater part of the engaged tissue, often vexatious with other instruments of this type

Throughout the procedure the operator must exert continuous downward pressure upon the instrument This is highly important Otherwise, the protruding mass might not fill the fenestra so as to be held firmly for transfixion with the electric needle After desiccation the tissues are extremely friable, and if the mass is

not held firmly, the needle will break away—that is, transfixion will fail, and when the knife is rotated there will be nothing to be cut off

AFTER TREATMENT

Following resection, a No. 20 or 24 F soft rubber catheter is left in the bladder for 24 to 48 hours. During this period irrigations of mild boric acid solution should be given. About 2 weeks after operation the bladder neck should be dilated with a No. 24 to 28 I sound. A slight loss of control may be present during this period, but continence will be re-established within a few weeks.

Cystoscopy should always precede operation with this instrument. The fenestra must remain closed during insertion to avoid any possible trauma to urethra and vesical neck. The bladder being filled with sterile water or boric acid solution the instrument is passed to it and the fenestra opened by merely turning the handle. The collar outside the tubular knife is marked to indicate whether the fenestra is open or closed. After desiccation of the tissue the needle remains embedded in it thus preventing its slipping upon application of the knife. If any fibers remain unsevered after the rotary cut is made they will be separated by the sliding of the knife from the sheath during withdrawal.

If it is desired to employ the instrument as a regular type of punch the sliding motion is available for that purpose being from within outward.

By the employment of this instrument a major operation is reduced to a procedure of minor importance accomplished with a minimum of bleeding and discomfort to the patient. The routine is easily acquired by anyone familiar with cystoscopic technique. It should prove convenient and efficient to any qualified operator.

CASE REPORTS

From the 5 to 30 cases in which the instrument has so far been used the following have been selected as illustrative of its adaptability. All of these patients have been benefited by the operative measure, frequency has been lessened and a general systemic improvement noted, due, no doubt to relief from bladder retention and the intoxications remotely traceable to it.

CASE 1. Patient of Dr. O. S. Lowsley. He was 39 years of age and gave a history of frequency and nocturia for preceding 3 years. Cystoscopic examination showed a definite median bar obstruction. The vesical neck resector was inserted and three cuts were made. There was no bleeding and the postoperative results were excellent. The greatest rise in temperature was to 100.6 degrees and the

catheter was withdrawn on the second postoperative day.

CASE 2. Hosp. No. 202099. Patient aged 63 years had suffered from frequency and nocturia for upwards of 3 years with hamaturia at times and one attack of acute retention. Upon examination the residual urine was found to amount to 4 ounces while the cystoscope showed definite median bar obstruction. Three cuts were made with the vesical neck resector followed by very slight bleeding but nothing which could be designated as hamorrhage. The catheter was removed on the second day the temperature never rising above 99.6 degrees throughout convalescence. The patient remained under observation because of suspicion of vesical carcinoma.

CASE 3. Hosp. No. 202045. Patient aged 49 years had symptoms of increasing frequency both by day and by night which had been observed during a 5 year period. There had been operative interference at another hospital 2 years ago followed by improvement which had persisted until about 3 weeks before his coming under the author's care. The cystoscopic examination at once revealed prostatic hypertrophy but as the patient refused prostatectomy an effort was made to relieve him by use of the vesical neck resector. Three cuts with this instrument afforded him apparent relief there was no hamorrhage and the catheter was removed on the second day. On one occasion the temperature rose to 102.4 degrees but convalescence was on the whole satisfactory with disappearance of the previous symptoms of obstruction.

CASE 4. Hosp. No. 203175. Patient aged 62 years had a vesical calculus with evident prostatic enlargement on cystoscopy. For a period of 3 months he had been experiencing pain at the termination of urination with increasing frequency, hamaturia and nocturia. There was a residual of from 5 to 10 ounces. The bladder neck was much contracted and three cuts with the vesical neck resector were required to open up the obstruction. There was no bleeding either during or following the intervention and the temperature reached 104 degrees on one occasion only.

CASE 5. Patient of Dr. I. I. Twinen. He was 57 years of age and gave a history of frequency and nocturia of 3 years duration. The residual urine measured from 2 to 11 ounces. Cystoscopically there was pronounced median lobe enlargement. Three cuts were made with the vesical neck resector and upon the specimens secured the pathologist reported chronic cystitis with a suspicion of vesical carcinoma. The patient has been much relieved by the instrumentation but remains under observation.

CASE 6. Patient of Dr. Twinen. He was 38 years of age and gave a history of frequency which had been in evidence for 6 months. There had been two attacks of complete retention but on measurement of the residual it was found seldom to exceed an ounce. There was a moderate prostatic hypertrophy and following the employment of the vesical neck resector the specimen was reported as showing inflammatory fibrosis and cellular infiltration. The results of the use of the instrument were excellent with but very slight bleeding for a short time after intervention.

SUMMARY AND CONCLUSIONS

The advantages of the vesical neck resector described are:

1. The absolute elimination of the profuse hamorrhage always heretofore produced by instruments of this type—a most important feature.
2. The possibility of definitely regulating the amount of heat applied. Slow desiccation of the

blood vessels eliminates sloughing which is prone to occur following the use of high temperature uncontrolled and with no method of determining how deeply the tissues are being seared

3 The fact that the circular knife cuts in the direct contour of the bladder neck. This is a very great advantage, but if the operator still prefers an instrument of the punch type, this resector is equipped to cut longitudinally, from within outward. The circular cutting type is nevertheless to be preferred

4 Vision is never at any time obscured. The operator can always see what he is doing. The vesical neck is always visible because it is continuously dilated by the constant irrigation. This is far superior to a method which depends upon the instrument itself for dilatation

5 The lateral position of the knife makes possible the cutting of a larger section. The fenestra differs from any previously designed in that all sharp edges and protuberances have been done away with, permitting free motion while searching for the vesical neck obstruction, without danger of traumatizing adjacent tissues

6 The needle which pinions the obstructing tissues permits fixation of the part to be operated upon, so it may be readily engaged. Slipping of the tissue under the knife has been one of the worst faults of most instruments of this type, often making clean cutting difficult or altogether impossible

NOTE.—In closing it is my great pleasure to acknowledge the friendliness and courtesy of Dr. Lowsley and the entire personnel of the James Buchanan Brady Urological Department of the New York Hospital, as well as of Doctors Deming and Vermooten, of Yale and my New York colleagues, Doctors Sturdivant Read, Barringer, Dean Valentine, Twinen DeVries, and Duff, who permitted me to make practical demonstrations of this instrument upon their patients. I would pay tribute also to the artistic attainments of Mr. William Didusch, by whose masterly work I have greatly profited. But my greatest debt of all is to Mr. Reinhold Wappler. Without his skill, persistence, and unrivaled mechanical ingenuity, my ideas would never have attained concrete form

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MAKING AND CLOSING OF ABDOMINAL INCISIONS¹

J. L. YATLS, M.D., AND FORREST R. RAIN, M.D., MILWAUKEE, WISCONSIN

SUITABLE incisions afford adequate exposure for intra abdominal operations, permit the margins of the wound to be protected against avoidable injury and contamination during operation, may be elongated if necessary, and can be so closed as to promote sound healing, prompt recovery of function, and thus warrant early reactivation of patients.

Detailed requirements are

1 Immediate separation of the layers to be approximated in closure,

2 Immaterial impairment of the circulation of blood and lymph in any layer

3 No transection of muscles

4 Transient, if any, interference with transmission of motor, tonic and sensory nerve impulses,

5 Elimination of forceful retraction during operation

6 Sound serosa to serosa closure of peritoneum and accurate approximation of properitoneal fascia to limit the inevitable formation of adhesions between omentum viscera, and parietal peritoneum to the line of closure (1) and to prevent separation of margins during the period of healing or the stretching thereafter which so frequently inaugurates hernia,

7 Replacement or approximation of muscles over the sutured peritoneum to afford the support needed for immediate protection and to prevent subsequent development of hernia,

8 Sound closure of the deep fascia to reinforce (6) and (7),

9 Approximation of the deep layer of the superficial fascia to foster healing of the fat and to prevent the skin from becoming adherent to the deep fascia

10 Skin margins approximated accurately but not so snugly as to prevent escape of serum and lymph,

11 Provision of separate pathways for drains so as to conform with (2) (3), and (4),

12 Utilization when indicated of stay sutures to relieve the tension in the structures and sutures in (6), (7), and (8), thus preventing their separation and partial or complete extrusion of viscera.

Paramedian, median, and gridiron incisions will fulfill these requirements if selected with regard to the nature of the intra abdominal operation and the anæsthetic² to be employed, if made long

enough to obviate the need of forceful retraction and if finesse be substituted for brute strength

PARAMEDIAN INCISIONS

Skin, fat, and fascia are incised over the middle of a rectus muscle. The mesial margin of the fascia is elevated and dissected from the underlying muscle (Fig. 1). No nerves and few vessels are injured. Muscle (protected by moist warm gauze) is retracted laterally and the peritoneum is incised (Fig. 2).

Approximation of the peritoneum before suturing is obtained by application of forceps of the Kocher type to its margins crossing them alternately, and exerting gradually the necessary amount of counter traction. The line of traction is not horizontal as indicated in the illustration (Fig. 3), but is upward as well as lateral. Thus the parietal peritoneum is sufficiently separated from the viscera and omentum so that the insertion of sutures under direct vision can be accomplished without danger of including deeper structures. It is usually convenient to insert a finger to depress the omentum as the stitches are introduced, thus providing absolute protection. A continuous mattress suture begins at one angle, and each stitch is pulled snugly, thus shortening the length of the incision (Fig. 3). It is locked at the opposite angle and continued back as an over and over stitch to approximate the properitoneal fascia and is tied to the end of the first mattress stitch (Fig. 4). The rectus muscle is replaced and anchored with a few stitches (Fig. 5). The rectus fascia is closed as represented in Figure 6 or, preferably, by a suture quite identical with that illustrated in Figures 3 and 4. Insertion of the continuous mattress stitch can be accomplished by exerting the margins of the deep fascia thereby avoiding further separation of fat from fascia and injuring this poorly healing tissue. The mattress portion of the stitching, stay like in its effect, provides relaxation of the margins which can then be approximated nicely with the over and over portion. Approximation of the deep layer of the superficial fascia with interrupted stitches of fine catgut is not illustrated. The skin may be closed any way in the abdominal muscles. Their contraction is interrupted by forceful retraction and intra-abdominal manipulation. In consequence closure becomes more difficult. Indeed satisfactory closure may be impossible and the likelihood of postoperative paresis or paralysis of the gastro-intestinal tract is great. Hence a preference for deep ether anaesthesia or spinal anaesthesia because the relaxation obtained by the local gas or combi gas and local anaesthesia as usually administered is less than required by the average operator.

² Difficulties in obtaining exposure are increased by incomplete relaxation.

if not too tightly. A satisfactory suture is indicated in Figure 7.

Postoperative separation of the margins of recent incisions is caused by traction exerted upon the sutures and the tissue included in them in consequence of increased intra-abdominal pressure (distention, vomiting, coughing, sneezing, often combined) and by unusual tension exerted by the lateral muscles rendered hypertonic from pain, peritoneal irritation, or in resistance to increased intra abdominal tension. Separation is caused more frequently by the tearing of the tissues than by disruption of the sutures. Whatever the cause of the separation, it can not only be obviated but the blood supply of the sutured structures can also be preserved if tension upon them is prevented. A means has been found to accomplish this prevention by applying the principle devised by Shipley for the re closure of separated incisions.¹

Sutures are passed, by means of a long straight Hagedorn needle, from within outward (Fig. 7). They include the margins of the deep fascia mesially and a bite laterally and are sufficiently long to make the line of tension tangential so as to obviate a cutting pressure upon the fat and skin. They are inserted through felt pads and then through stitch apertures in buttons. Manual pressure is applied to the sides of the abdomen so as to relax the structures along the line of closure. The tension sutures are pulled up snugly enough to maintain this relaxation and are fixed.

Experiments upon animals conducted at Columbia Hospital and limited clinical observations indicate that these tension sutures need not be double as illustrated, that bronze wire is superior to silver wire, and that heavy (waxed?) silk may be the best. The method seems to be efficacious. Relaxation of the sutures as convalescence progresses is desirable if they cause distress or induce local irritation. If the skin beneath the felt pads is cleansed daily with alcohol, the sutures may be retained for 14 days without serious damage, and by that time patients are walking and the danger of separation of the incision is passed.

¹We have tried to employ stay sutures of stained and unstained silk worm gut in every possible way as simple loops, single and double figures of eight, tied loosely and snugly, with and without including gauze between suture and skin. The cutting capacity of silk worm gut is superior to some scalpels; its irritation of skin exceeds that of other suture materials, possibly excepting horse hair. If the sutures be tied too snugly they cut through tissues including skin. If they be tied too loosely they are not even good setons. If they be tied neither too snugly nor too loosely they do almost no harm but little good. Every surgeon has seen disruption of wounds properly closed with silk worm gut stay sutures. Most wounds closed without stay sutures will not disrupt. There is a popular superstition among operators that the introduction of silk worm gut stay sutures contributes to the failure of such wounds to disrupt. Surgeons appreciate facts and welcome the principles established in Shipley's ingenious contribution.

A small proportion of abdominal wounds require stay sutures to provide satisfactory healing. Their utilization is indicated if patients are deficient in stamina or in capacity to form fibrin, if the tissues of the individual are unusually friable, if distention is present or is likely to develop, and if retraction of the parietes during operation makes closure difficult, and unwholesome tension upon tissues and sutures is immediate.

Figure 8 shows the re-closure of a separated median suprapubic incision as advocated by Shipley. The adhesive plaster was applied to approximate skin and still permit egress of secretions. Figures 9 and 10 show stay sutures introduced at operation to prevent separation of a median suprapubic incision. The forward bulging of the abdominal wall between the buttons, indicating the relaxation provided, had been maintained for 7 days when the photograph was taken and persisted for another week when the stay sutures were removed (Fig. 10). Adhesive plaster had been applied to retain approximation of the skin after its sutures had been removed on the second day. Figure 12 illustrates the utilization of stay tension sutures to prevent separation of a paramedian incision and to warrant earlier safe activation of an obese patient who was deficient in stamina. Ends of bronze wire stay sutures had been left long so that they might have been brought together over the wound dressings if additional support became necessary and thus make it safe to pull them but moderately taut when the incision was closed. They were retained a fortnight without causing distress or inducing more than superficial irritation. Figure 13 shows single stay sutures of waxed silk used to protect a left paramedian incision made to remove the spleen from an 8 year old boy much weakened from fulminating thrombocytopenic purpura. The photograph was taken the fifth day after operation. All stitches had been placed unusually close together to prevent oozing. This is indicated by the button hole sutures in the skin. Dark areas about the incision were subcutaneous hemorrhages that occurred despite meticulous ligation of vessels. A mild infection developed in the fat and extended to the left along the middle stay suture which was removed on the tenth day. Recovery was otherwise uneventful.

MEDIAN INCISIONS

Both suprapubic and infrasternal forms may be preferable to paramedian incisions if it be desirable in addition to an intra abdominal procedure to correct an epigastric or an umbilical hernia or a wide diastasis of the rectus muscles.

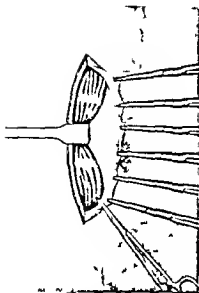


Fig. 1

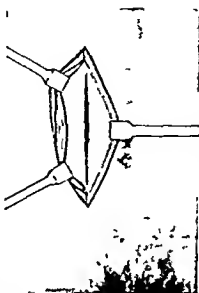


Fig. 2

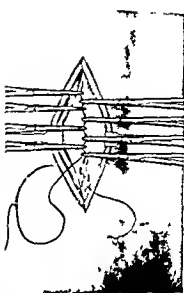


Fig. 3

Fig. 1 Paramedian incision. Skin, fat and fascia incised over middle of a rectus muscle. Mesial margin of fascia elevated and dissected from underlying muscle. Few vessels and no important nerves are injured. Muscle (protected with moist warm gauze) is retracted laterally.

Fig. 2 Paramedian incision. Peritoneum incised at or lateral to the middle of the rectus muscle so that the line of subsequent closure will not be too near the linea alba. If exposure proves inadequate the incision may be extended in either direction without jeopardizing early restoration of function.

Fig. 3 Closure of a paramedian incision. Approximation of peritoneum obtained by application of forceps to its margins, crossing them alternately and exerting gradually the countertraction required, not so horizontally as illustrated but forward as well. Insertion of the first row of stitches, a continuous mattress suture, begins at either angle under direct vision. Depressing the omentum and viscera by inserting a finger beneath the peritoneum facilitates sewing, and affords absolute protection against including them in a stitch. When the peritoneum is closed by uniting, serosa to serosa the last mattress stitch is locked.

Exposure of the pelvic viscera in women is the common requirement and diastasis of the rectus muscles is usual in multiparae and frequent in nulliparae. It is often necessary to excise the umbilicus (Fig. 14) to provide a satisfactory closure.

Peritoneum is approximated and sutured as illustrated in Figures 3 and 4. The mesial borders of the rectus muscles are united with interrupted stitches (Fig. 15). In closure of the rectus fascia imbrication is desirable if feasible in order to add support to the approximated rectus muscles by reducing the size of the rectus sheath and to secure firmer healing. Closure of fat and skin and insertion of stay sutures have been described and illustrated.

GRIDIRON INCISIONS

Criticisms of lateral muscle splitting incisions upon the grounds that obtainable exposure is sometimes too limited and that injury to nerves is frequently unavoidable are but partially justified. If the level of separation of the fibers of the internal oblique and transversalis muscles is adapted to the position and course of the twelfth thoracic and hypogastric nerves (Fig. 16) they

may be mobilized and displaced without injuring them permanently. Thus the peritoneum can be exposed widely, and, if this proves inadequate the rectus fascia can be incised as introduced by Harrington and Weir and the lateral border of the rectus muscle retracted mesially (Fig. 17). The additional exposure provided permits gridiron incisions to be employed in the great majority of operations for which it is suited, notably appendectomy, for which it was devised by McArthur though first published by McBurney.

Accurate approximation of layers in the closure of these incisions is requisite to promote satisfactory healing, although healing will occur if only the peritoneum is sutured.

Peritoneum is approximated by the use of forceps (Fig. 3) and sutured with a continuous mattress suture. If the rectus sheath has not been incised the forceps used to provide approximation of the peritoneal layer are tilted, after the mattress suture is completed, away from, instead of toward the opposite margin and the ends of the suture are tied around them, thereby reducing the closure from a line to a point. If the wound has been enlarged, each stitch in the continuous mat-

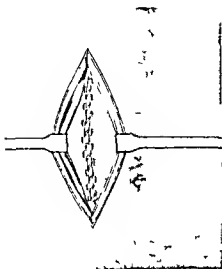


Fig 4

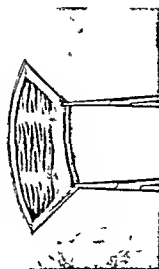


Fig 5

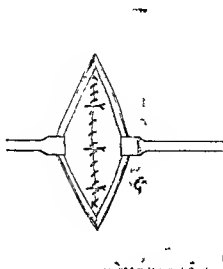


Fig 6

Fig 4 Closure of a paramedian incision. When the peritoneum has been completely reunited by serosa to serosa approximation, the last mattress stitch (Fig 3) is locked and continued as an over and over suture to appose the everted margins of the peritoneum below Douglas's fold and the transversalis fascia above it. It is tied to the end of the first mattress stitch.

Fig 5 Closure of a paramedian incision. Rectus muscle is replaced and anchored with a few stitches, particularly at tendinous insertions.

Fig 6 Closure of a paramedian incision. Rectus fascia may be repaired with a simple over and over stitch reinforced, if necessary, with a few interrupted sutures.

press suture is pulled snugly, thus puckering the everted margins and reducing the length of the line of closure. Approximation of the transversalis muscle hastens repair and restricts exudation. The internal oblique should be united so that the anterior surface is accurately apposed in order to limit adhesions to the under surface of the external oblique (Fig 18). Imbrication of the margins of the fascia of the external oblique assures the stronger reunion of surfaces instead of edges. Interrupted stitches of fine catgut suffice and must not include nerves. Closure of superficial layers has been described.

DRAINAGE

Drains are foreign bodies employed to provide a prompt formation of adhesions between contiguous structures in order to exclude a dangerous area from the balance of the peritoneum (6) and to provide an extraperitoneal outlet for the serous and other exudates that will form within it and the secretions (bile, urine, intestinal contents) that may enter it. They may be utilized prophylactically (e.g., after cholecystectomy, suture of intraperitoneal rupture of the urinary bladder, hysterectomy, intestinal resection), haemostatically (removal of an enlarged adherent spleen) or after opening an intraperitoneal abscess.

Whatever the reason for drainage, the amount of foreign body introduced should be restricted, so far as safety permits, and should consist of units that may be withdrawn successively to allow the tract to collapse and finally to close from the

bottom. The units should if possible be soft and smooth and if gauze is required to check haemorrhage all but the portion in contact with the bleeding surface should be enveloped in protective gutta-percha. The intraperitoneal portion, so far as possible, should be surrounded with omentum, particularly as it enters the parietal peritoneum.

The only serious problem is how to place drains in the parietes in reference to the type of incision that has been employed and the reason for drainage. Prophylactic drains are small and may, if a median incision is used, be brought out through an angle thereof. If paramedian or gridiron incisions be used it is wise to make an additional lateral stab incision for the drains. So too haemostatic drains are provided with a separate channel. A lateral stab opening is but a limited gridiron incision made by a short cut in the skin, in the deep fascia in line with the direction of its fibers, blunt separation of the muscles, and pushing the forceps through the parietal peritoneum. The tract is stretched by opening the forceps and the ends of the drains, already placed, are grasped in the forceps and pulled out through the skin until taut.

Drainage of abscess cavities depends upon the character of the infection and again upon the type of incision as well as upon how effectively it has been protected from contamination during operation. If the abscess has been provoked by the ordinary pyogenic organisms or by tubercle bacilli, the same procedure as indicated in establish-

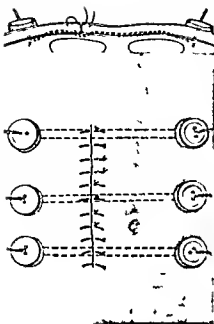


Fig 7

Fig 7 Closure of a paramedian incision. A satisfactory type of interrupted skin stitch is indicated in the drawing and in the diagram above it. The stay sutures also indicated in drawing and diagram illustrate the method of using them when the parietal structures are thin and friable. A single suture of heavy silk is preferable to the wire shown in the illustration and so arranged that the buttons are more nearly equidistant from the incision.

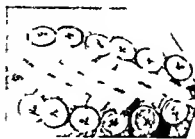


Fig 8



Fig 10



Fig 9

Inclusion of deep fascia as indicated at 11 in the diagram is needed only when the skin and panniculus of thin patients fail to offer sufficient resistance to traction exerted by the sutures and buttons.

Fig 8 Reclosure of separated median suprapubic incision with silver wire and buttons as advocated by Shipley.

Fig 9 Stay sutures used to prevent separation of median suprapubic incision employed to remove

carcinomatous uterus. Forward bulging of parietes between buttons indicates relaxation of parietes maintained for 7 days. Adhesive plaster strips had been applied on the second day after skin stitches were removed. Cigarette drains in lower angle allowed to remain because bloody ascites were present at operation and drainage had not ceased.

Fig 10 Lateral view of same patient shown in Figure 9

ing prophylactic drainage may be employed. No matter how carefully the margins of the operative incisions be protected some contamination is unavoidable. Subsequent infection is less certain to develop if the amount of catgut used in closure is reduced to limits of safety and will be less disastrous if interrupted stitches be employed instead of continuous sutures. Although stay sutures are undesirable they may be imperative save in gridiron incisions. The skin should be loosely approximated, preferably with adhesive plaster.

Presence of the anaerobic gangrene producing bacteria in the abscess is a threatening complication which usually can be detected by the peculiar odor. Infection of the incision is quite inevitable and will produce necrosis particularly of fat and fascia. These anaerobes are with rare exceptions present only in periappendicitis. Should a gridiron incision be employed, it is safe to place the drains in the opening and close it loosely if at all. A hernia is likely to develop no matter what is done, sutures and making an additional incision for the drains only add to the extent of tissue destruction. If a paramedian incision is used it is wise to make an additional lateral stab incision so

as to bring the drains out most directly through the parietes and thus limit the intraperitoneal reactions even though the operation incision is going to become infected. This, be it noted, is an argument in favor of using a gridiron incision routinely in operations for appendicitis, especially if an abscess be present.

In brief, the principles that govern the institution of drainage are the same as those that control the making of abdominal incisions. They differ in that drainage openings are allowed to close spontaneously.

EXPERIENCE

Median, paramedian, and gridiron incisions have been employed for 15 years. The (1) exposure during operation, the (2) amount of retraction required, the (3) opportunity to keep the margins of the wound covered with moist warm gauze, the (4) ease and safety of elongating the original incisions, (5) method of repair, (6) immediate healing, (7) rapidity of recovery of function, (8) avoidance of hernias, and (9) the prospective intervals of inactivations have been studied.

1. The extent of exposure required dependent as it is upon the relaxation provided by the anas-

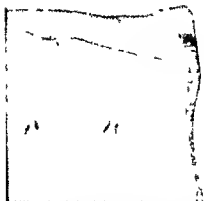


Fig 11

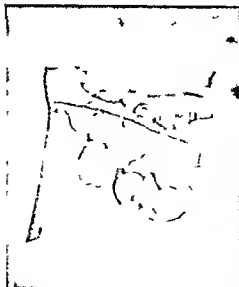


Fig 12



Fig 13

Fig 11 Same patient shown in Figures 9 and 10 on the fifteenth day after stay sutures had been removed. Cutting of skin by wire sutures, though avoidably extensive, caused little distress. Tension upon sutures was needlessly high.

Fig 12 Stay sutures used in closure of paramedian incisions, but less tension employed than in previous patient. Ends of bronze wire sutures left long to be brought together over wound dressings if it became necessary to provide additional support. These sutures were retained for a

fortnight without causing distress and induced only slight superficial irritation.

Fig 13 Stay sutures inserted to support a left paramedian incision made for splenectomy because of fulminating thrombocytopenic purpura. Dark areas about incision are subcutaneous hemorrhages that occurred despite efforts to produce hemostasis. Ends of single wavy stay suture left long so they could be tied should distention occur.

thetia, the nature of the intra abdominal lesions, the thickness of the abdominal wall and the adroitness of the operator, is commonly underestimated. Based upon the fact that a long incision properly made and closed heals as rapidly and as soundly as a limited incision, it is certain that an incision just long enough is usually a little too short. It is unrecorded that the performance of an intra abdominal operation accurately, thoroughly, and gently was ever prevented by a too easy approach.

2 Wider exposure reduces the amount of retraction required, and the less the retraction the less the contraction of the lateral muscles which, in addition to tympanites, is the main obstacle to obtaining a satisfactory closure.

3 Keeping the margins of the wound warm and moist, protecting them from chemical irritation, bacterial contamination, and at the same time minimizing the trauma from retractors, facilitates healing but requires longer incisions.

4 Elongation of median and paramedian incision without jeopardizing healing materially is limited by the length of the rectus muscles. Elongation of gridiron incisions suffices to permit removal of appendices though they be adherent in the pelvis. Rarely a long appendix adherent to cæcum and ascending colon can not be removed

safely through the original incision, but can be exposed adequately if another similar incision be made at a higher level after the skin and external oblique are retracted upward.

5 Methods for suturing the layers exposed by the three incisions have varied with untoward experiences and transient superstitions. The facts are clear. Some contamination of every wound is inevitable and is consequential only when the virulence of the bacteria exceeds the resistance offered by the tissue upon which they have been deposited. This resistance is augmented to an even greater degree by the blood delivered to these tissues. Consequently, if structures exposed are shielded from injury and are so closed that they retain an effective blood supply, the amount of suture material needed to effect a sound closure can be used without detriment to healing. Should the virulence of the contaminating bacteria be excessively high, infection is inevitable, and if this be known, closure should be modified and drainage instituted so as to make the effects least disastrous. The problem of stay sutures awaits a solution that time and experience will ratify. At present it is evident that the requirements for a satisfactory solution are to prevent tension upon the tissues united by sutures, to preserve an adequate circulation of blood and

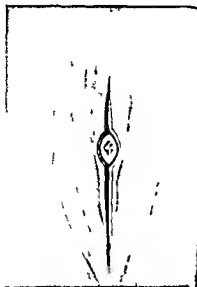


Fig 14

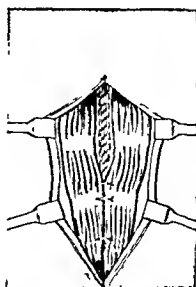


Fig 15

Fig 14 Median suprapubic incision. Incision made to remedy diastasis of recti muscles as well as to provide wider exposure.

Fig 15 Closure median suprapubic incision. Combined continuous mattress and over-and-over sutures used to close peritoneum and the transversalis fascia above Douglas fold. Recti muscles being approximated with interrupted sutures.

lymph within them, and to interfere immaterially with the transmission of nerve impulses to and from them.

6 Immediate healing has been less satisfactory than when other methods were employed. Limited subcutaneous accumulations of serum occur perhaps too frequently. Disintegration of fat, sometimes accompanied by a mild infection, is occasional. Sloughing of the deep fascia is unusual and has been significant only in prolonging convalescence.

In one patient, an obese physician who had a gangrenous cholecystitis and an acute appendicitis with an abscess which contained anaerobic bacteria, the rectus muscle sloughed completely after a paramedian incision.

In one patient, from whom a strangulated ovarian cyst had been removed through a median suprapubic incision and silk worm gut stay sutures were employed in closure the wound, because her sutures cut loose from coughing, disrupted on the seventh day. Her abdomen was re-closed (Fig 8) as advocated by Shipley and she recovered. Disruption of the wound in another patient occurred on the fifth day from tympanites and vomiting after cholecystectomy and appendectomy. A paramedian incision had been employed and no stay sutures were used in closure. Re-closure of the wound and a jejunostomy failed to prevent

death from paralytic ileus. A suprapubic incision which was closed with silk worm gut stay sutures disrupted, when the patient coughed, on the eighth day after a tuberculous uterus had been removed. The wound was resutured and the patient recovered. Gridiron incisions employed to correct peri appendicular abscesses that contain chiefly colon bacilli are less apt to suppurate if lateral drainage is provided and the skin closed loosely if at all. If the abscess contains the gangrenogenic anaerobes, suppuration and necrosis of the gridiron incision occur no matter what is done.

7 Contraction of rectus muscles after median and paramedian incisions and of the lateral muscles after gridiron incisions is not interrupted by operation though it is restricted by pain. Gradually, increasing exercise, begun early, hastens recovery and does not, so far as has been observed, tend to disrupt incisions.

8 The incidence of postoperative hernia can not be determined. The only hernia following a paramedian incision occurred in the case of a physician whose rectus muscle sloughed. It caused no discomfort. A few hernias have followed median suprapubic incisions in consequence of suppuration. Hernias have developed in gridiron incisions only if sloughing has been pronounced.

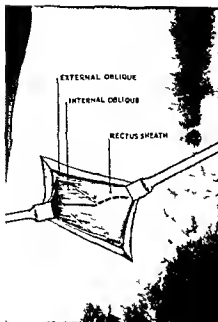


Fig 16

Fig 16 Gridiron incision. Solid line indicates level of separation of fibers of internal oblique in reference to the twelfth thoracic and iliohypogastric nerves. Broken line indicates incision of rectus sheath to obtain the greater exposure suggested by Harrington and Weir.

Fig 17 Gridiron incision. Exposure obtained by adding the procedure of Harrington and Weir to the incision of McArthur and McBurney. Mobilization and displacement

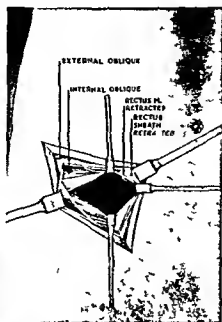


Fig 17

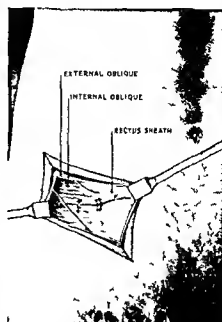


Fig 18

of the twelfth thoracic nerve upward and of the iliohypogastric downward protects these structures from injury.

Fig 18 Closure of gridiron incision. After the pentoneum had been closed and the margins of the transversalis muscle approximated, the external oblique and rectus fasciae were so sutured as to approximate their smooth ventral surfaces and thus reduce the tendency to form adhesions with the contiguous surface of the external oblique.

9 Reactivation of patients, in so far as incisions are concerned, should be as rapid as conditions warrant and as an individual's strength and temperament permit. Well healed gridiron incisions permit patients to leave on the fifth day, some even sooner. Soundly closed paramedian incisions, if tissues are strong, warrant discharge of robust patients in a week, median incisions of this character in 10 days.

CONCLUSIONS

Simple incisions that provide adequate exposure for the majority of intra-abdominal operations, that can be closed soundly, heal rapidly, assure an early recovery of usual activities, and obviate subsequent complications, must be adapted to conform with the structure, function, blood and nerve supply of the parietal tissues.

Median, paramedian, and gridiron incisions can usually be so utilized as to fulfill these requirements, provided the relaxation provided by anesthesia suffices to prevent forceful muscular contractions during operation, and the closure obtained does not impair healing, is sound enough to prevent early disruption of the wound or the ultimate stretching that leads to diastasis and to hernia.

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OLSHAUSEN'S OPERATION FOR SUSPENSION OF THE UTERUS

A REVIEW OF THREE THOUSAND THREE HUNDRED AND FIFTY-EIGHT CASES OPERATED UPON AT THE
FREE HOSPITAL FOR WOMEN, BROOKLINE

WILLIAM P. GRAVES, M.D., F.A.C.S. AND GEORGE VAN S. SMITH, M.D., BROOKLINE, MASSACHUSETTS

THE Olshausen's operation is the oldest, the simplest to perform, and, in our experience, the most effective of the numerous methods devised for suspending the misplaced uterus. It consists merely in attaching the uterine ends of the round ligaments to the anterior abdominal wall.

HISTORICAL NOTE

The early history of suspension operations has best been told in a footnote on page 306 of the 1905 edition of Hirst's *Text Book of Diseases of*

Women. It reads "Olshausen was the first to perform a modern uterine suspension. Kelly introduced it into America after a visit to Olshausen's clinic. Sims, Keltenbach, Koerberle, Schroeder, Hennig, and Tait had previously attempted to fasten the uterine fundus to the anterior abdominal wall. Boldt and Leopold, in 1890, passed the sutures through the uterine fundus instead of through the uterine cornua and ovarian ligaments as Olshausen originally did."

The Olshausen's operation was first performed at the Free Hospital for Women in 1890 by Dr. W. H. Baker and was frequently employed by him. The writer (Graves) began using it more than 20 years ago in a series of cases to test the comparative efficiency of the various methods then in vogue for suspending the uterus. Among the other operations included in the test were those devised by Alexander, Wiley, Gilliam, Kelly, Mayo, Simpson, Baldy, and Webster, in all of which the round ligaments were employed. The results of these observations which extended over a number of years were overwhelmingly in favor of the Olshausen's operation, and the writer in 1923 published his conclusions in an article entitled "Olshausen's Operation for Suspension of the Uterus," which he read before the New York Obstetrical Society.

MERITS OF THE OPERATION

The advantages of the Olshausen's operation may be briefly summed up as follows:

1 Its technical simplicity and the consequent rapidity with which it can be performed are unexcelled.

2 It is but an incident in closing the abdominal wound, and can be used with insignificant loss of time in finishing long and complicated operations.

3 It has great supporting power, so that it may be successfully employed in the most extreme cases of procidentia.

4 Since the suspension can be made, on the one hand, at varying levels on the abdominal wall, or at varying distances from the uterine horns, on the other, it is applicable to any length of uterus or degree of prolapse.

(Am J Obst & Gynec 1923 Aug)

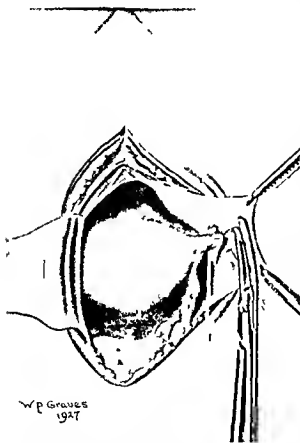


Fig. 1. Olshausen's operation. On the right the double ligature (silk, linen or catgut) has been placed and tied with the knot inside the abdomen. On the left the needle carrying the ligature is being passed under the round ligament at a short distance from the uterine horn. (From Graves *Gynecology*.)

5 Symptomatically it results in a maximum of pelvic comfort on account of the high plane in which it holds the uterus, the avoidance of pressure on the bladder, the practically normal mobility of the uterus and appendages, and the excellent drainage that it insures of the genital circulation

6 When the operation is used as a prophylactic measure against a later retroversion in all conservative pelvic operations, then it is a valuable means of securing permanent symptomatic cures

7 Since the operation entails a minimum distortion of the pelvic organs and postoperative adhesions, later pelvic operations that may be necessary are not hindered or confused

8 The operation can be used in childbearing women with comparatively little danger of dystocia, and therefore artificial sterilization is not necessary

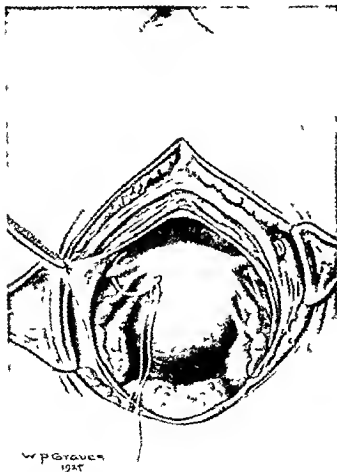


Fig 2 Olshausen's operation. Special technique when catgut is used. In order to insure a firm adhesion the bight in the round ligament included in the tie is scarified. On the abdominal side a small slit is made in the peritoneum. (From Graves Gynecology.)

DEFECTS

Long experience with the Olshausen's operation has revealed certain defects that we have endeavored to obviate as far as possible. Until recent years all the operations were performed with heavy silk, which occasionally produced a post-operative sinus. The permanency of the operation was not affected, since the stitch always worked through into the muscular layer, the artificial adhesions remaining intact. In some cases the stitch required an operation for its removal. This unpleasant complication may be largely avoided by the use of linen, and completely so by the use of catgut in the manner to be described (Fig 2).

The most important danger associated with the Olshausen's operation is obviously that of a later

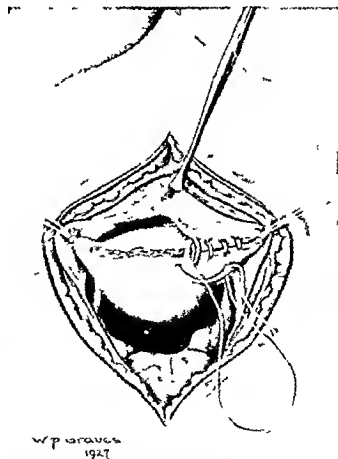


Fig 3 Olshausen's operation. Modification often used in cases of proclutia beyond the childbearing period when the peritoneum is atrophied. The suspension is first performed in the usual way. For the purpose of gaining additional supporting power the fundus of the uterus is either scarified or as in the drawing denuded by the removal with scissors of a narrow strip of peritoneum. The fundus is then attached with a running catgut stitch to the peritoneum of the anterior abdominal wall. The modification is never used if there is a possibility of later pregnancy. (From Graves Gynecology.)

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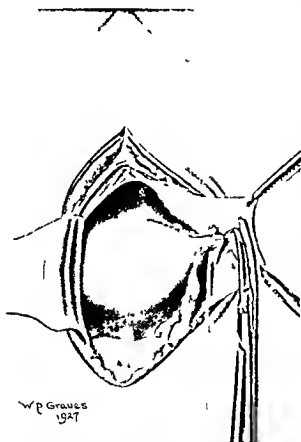


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OPERATIONS IN WHICH OLSHAUSEN'S SUSPENSION WAS PERFORMED

SIMPLE RETROVERSION—678 CASES

| | Cases | Per cent |
|-----------------------------------------------------------------------------|-------|----------|
| Untraceable | 128 | 18 3 |
| Traceable more than 2 years after operation | 326 | 48 0 |
| Examined more than 1 month after operation | 416 | 61 3 |
| Examined 2 or more years after operation | 85 | 12 5 |
| Operative mortality | 1 | 0 14 |
| Retropitoneal abscess from prolapse of bladder removed at time of operation | | |

Gross results from all follow ups—

| | | |
|-----------------------------------------------------|-----|------|
| Symptomatic— | | |
| Cured | 65 | 67 5 |
| Relieved | 132 | 24 4 |
| Failure | 43 | 8 1 |
| Anatomical position of uterus (examined)— | | |
| In position | 317 | 90 5 |
| Partial recurrence | 19 | 5 4 |
| Recurrence | 14 | 4 0 |
| Results based on follow ups of more than two years— | | |
| Symptomatic— | | |
| Cured | 207 | 63 4 |
| Relieved | 93 | 28 2 |
| Failure | 27 | 8 2 |
| Anatomical position of uterus (examined)— | | |
| In position | 64 | 75 2 |
| Partial recurrence | 9 | 10 5 |
| Recurrence | 12 | 14 1 |

Pregnancy after operation—

A After anterior colporrhaphy or perineorrhaphy or both and suspension—

| | Cases |
|-----------------------------------------------|-------|
| Total patients | 34 |
| Pregnancies in 34 cases | 69 |
| Pregnant at time of follow up outcome unknown | 4 |
| Results in remaining cases— | |
| Normal deliveries | 39 |
| Abortions | 12 |
| Miscarriages | 2 |
| Breech delivery | 1 |
| Caesarean section | 4 |
| Instrumental deliveries | 9 |
| Two normal deliveries | 7 |
| Two instrumental deliveries | 1 |
| Four normal deliveries | 1 |
| Five normal deliveries | 1 |
| Four caesarean deliveries | 1 |

Examined after childbirth—

| | Cases | Per cent |
|------------------------------------------------------------------------------------------------------|-------|----------|
| Uterus in position | 8 | 61 5 |
| Partial recurrence | 2 | 15 3 |
| Recurrence | 3 | 2 3 |
| B No plastic beyond dilatation and curettage trachelorrhaphy, amputation or cauterization of cervix— | | |
| Total cases | 109 | |

Pregnancies in 109 cases

Pregnant at time of follow up, outcome unknown

Tubal pregnancies (1 placenta prævia)

Results in remaining cases—

| | Cases | Per cent |
|-----------------------------|-------|----------|
| Normal deliveries | 102 | |
| Abortions | 34 | |
| Miscarriage | 6 | |
| Premature deliveries | 4 | |
| Breech deliveries | 3 | |
| Caesarean deliveries | 7 | |
| Instrumental deliveries | 23 | |
| Two normal deliveries | 8 | |
| Three normal deliveries | 7 | |
| Four normal deliveries | 5 | |
| Seven normal deliveries | 1 | |
| Two instrumental deliveries | 2 | |
| Two caesarean sections | 2 | |

Examined after childbirth—

| | Cases | Per cent |
|--------------------|-------|----------|
| Uterus in position | 9 | 52 9 |
| Partial recurrence | 4 | 23 5 |
| Recurrence | 4 | 23 5 |

ANTEFLEXION AND RETROCESSION—357 CASES

| | Cases | Per cent |
|---------------------------------------------|-------|----------|
| Untraceable | 70 | 19 6 |
| Traceable more than 2 years after operation | 171 | 47 9 |
| Examined more than 1 month after operation | 202 | 50 5 |
| Examined 2 or more years after operation | 40 | 11 2 |
| Operative mortality | — | — |

Gross results from all follow ups—

| | | |
|-------------------------------------------|-----|------|
| Symptomatic— | | |
| Cured | 138 | 50 9 |
| Relieved | 109 | 40 2 |
| Failure | 34 | 12 5 |
| Anatomical position of uterus (examined)— | | |
| In position | 182 | 90 9 |
| Partial recurrence | 12 | 5 9 |
| Recurrence | 8 | 3 4 |

Results based on follow ups of more than 2 years—

| | | |
|-------------------------------------------|----|------|
| Symptomatic— | | |
| Cured | 76 | 44 4 |
| Relieved | 76 | 44 4 |
| Failure | 19 | 11 1 |
| Anatomical position of uterus (examined)— | | |
| In position | 30 | 75 0 |
| Partial recurrence | 6 | 15 0 |
| Recurrence | 4 | 10 0 |

Pregnancy after operation—

| | |
|-------------------------------|------|
| Total traceable cases | 124 |
| Pregnancy occurred in | 24 |
| Total pregnancies in 67 cases | 67 |
| Pregnant at time of follow up | 23 3 |
| Tubal pregnancy | 15 3 |
| Results in remaining cases | |
| Normal deliveries | 24 |
| Abortions | 11 |
| Miscarriages | 3 |
| Premature delivery | |

| | | Cases | | | | Cases | |
|-------------------------------------------------------------------|-------|---------|--|-----------------------------------------------------------|-------|---------|-------|
| Breech delivery | | 3 | | Abortions | | 57 | |
| Cæsarean section | | 1 | | Miscarriages | | 15 | |
| Instrumental deliveries | | 37 | | Premature deliveries | | 6 | |
| Two normal deliveries | | 7 | | Breech delivery | | 1 | |
| Three normal deliveries | | 6 | | Instrumental deliveries | | 30 | |
| Four normal deliveries | | 2 | | Cæsarean deliveries | | 23 | |
| Five normal deliveries | | 1 | | Two instrumental deliveries | | 8 | |
| Two instrumental deliveries | | 5 | | Four instrumental deliveries | | 1 | |
| Three instrumental deliveries | | 1 | | Two cæsarean sections | | 3 | |
| Four instrumental deliveries | | 1 | | Two normal deliveries | | 19 | |
| Examined after childbirth— | | | | Three normal deliveries | | 10 | |
| Uterus in position | Cases | Percent | | Four normal deliveries | | 4 | |
| Partial recurrence | 7 | 53.8 | | Five normal deliveries | | 1 | |
| Recurrence | 5 | 39.4 | | Examined after childbirth— | | | |
| | 1 | 7.6 | | Uterus in position | Cases | Percent | |
| PROLAPSE—1422 CASES | | | | Partial recurrence | 48 | 18.6 | |
| Untraceable | Cases | Percent | | Recurrence | 2 | 3.2 | |
| Traceable more than 2 years after operation | 215 | 15.1 | | | 11 | 18.0 | |
| Examined more than 1 month after operation | 821 | 57.0 | | PROCIDENTIAL—294 CASES | | | |
| Examined 2 or more years after operation | 922 | 57.8 | | Untraceable | Cases | Percent | |
| Operative mortality— | 241 | 16.9 | | Traceable more than 2 years after operation | 30 | 10.2 | |
| 1 48 years of age pulmonary embolism 10 days after operation | 9 | 0.36 | | Examined more than 1 month after operation | 162 | 55.1 | |
| 2 54 years of age pulmonary embolism 10 days after operation | | | | Examined 2 or more years after operation | 173 | 58.8 | |
| 3 48 years of age pulmonary embolism 1 day after operation | | | | Operative mortality | 63 | 22.1 | |
| 4 42 years of age, pulmonary embolism 1 day after operation | | | | 1 20 years old pneumonia 4 days after operation | 3 | 1.02 | |
| 5 38 years of age, intestinal obstructions 4 days after operation | | | | 2 65 years old pulmonary embolism 13 days after operation | | | |
| 6 56 years of age pneumonia 4 days after operation | | | | 3 60 years old surgical shock, 3 days after operation | | | |
| 7 59 years of age under anesthesia | | | | Gross results from all follow ups— | | | |
| 8 36 years of age cerebral embolism 6 days after operation | | | | Symptomatic— | | | |
| Gross results from all follow ups— | | | | Cured | 183 | 65.5 | |
| Symptomatic— | Cases | Percent | | Relieved | 47 | 19.6 | |
| Cured | 853 | 72.0 | | Failure | 9 | 3.7 | |
| Relieved | 291 | 23.7 | | Anatomical position of organs (examined)— | | | |
| Failure | 50 | 4.2 | | In position | 126 | 72.4 | |
| Anatomical general results— | | | | Partial recurrence | 49 | 22.0 | |
| In position | 770 | 94.8 | | Recurrence | 8 | 4.5 | |
| Partial recurrence | 30 | 3.6 | | Results based on follow ups of more than 2 years— | | | |
| Recurrence | 22 | 2.6 | | Symptomatic— | | | |
| Results based on follow ups of more than 2 years— | | | | Cured | 118 | 72.8 | |
| Symptomatic— | Cases | Percent | | Relieved | 36 | 22.2 | |
| Cured | 582 | 71.7 | | Failure | 9 | 4.9 | |
| Relieved | 196 | 24.1 | | Anatomical position of organs (examined)— | | | |
| Failure | 33 | 4.0 | | In position | 40 | 60.6 | |
| Anatomical position of organs (examined)— | | | | Partial recurrence | 19 | 28.7 | |
| In position | 209 | 86.7 | | Recurrence | 7 | 10.6 | |
| Partial recurrence | 16 | 6.6 | | Pregnancy after operation— | | | Cases |
| Recurrence | 16 | 6.6 | | Traceable cases | | 264 | |
| Pregnancy after operation— | Cases | | | Pregnancy occurred in | 18 | 6.8 | |
| Total patients | 199 | | | Total pregnancies in 18 case | | 36 | |
| 1 pregnancies in 199 cases | 323 | | | Pregnant at time of follow up | | 2 | |
| 1 pregnant at time of follow up outcome unknown | 19 | | | Results in remaining pregnancies— | | | |
| Results in remaining pregnancies— | | | | Normal deliveries | | 9 | |
| Normal deliveries | 152 | | | Abortions | | 9 | |
| | | | | Miscarriages | | 5 | |
| | | | | Premature deliveries | | 3 | |
| | | | | Cæsarean deliveries | | 6 | |
| | | | | Instrumental deliveries | | 2 | |

Examined after childbirth—

| | Cases | Per cent |
|--------------------|-------|----------|
| Uterus in position | 8 | 72.7 |
| Partial recurrence | 1 | 9.0 |
| Recurrence | 2 | 18.1 |

PELVIC INFLAMMATION (CONSERVATIVE
OPERATIONS)—415 CASES

| | Cases | Per cent |
|---------------------------------------------|-------|----------|
| Untraceable | 94 | 22.5 |
| Traceable more than 2 years after operation | 191 | 46.0 |
| Examined more than 1 month after operation | 259 | 62.4 |
| Examined 2 or more years after operation | 70 | 16.8 |
| Operative mortality (peritonitis) | 1 | 0.24 |

Gross results from all follow ups—

| | | |
|-------------------------------------------|-----|------|
| Symptomatic— | | |
| Cured | 204 | 63.9 |
| Relieved | 102 | 31.9 |
| Failure | 13 | 4.0 |
| Anatomical position of uterus (examined)— | | |
| In position | 212 | 81.8 |
| Partial recurrence | 38 | 14.6 |
| Recurrence | 9 | 3.4 |

Results based on follow ups of more than 2 years—

| | | |
|-------------------------------------------|-----|------|
| Symptomatic— | | |
| Cured | 124 | 64.2 |
| Relieved | 61 | 31.6 |
| Failure | 6 | 4.2 |
| Anatomical position of uterus (examined)— | | |
| In position | 47 | 67.1 |
| Partial recurrence | 18 | 25.7 |
| Recurrence | 5 | 7.2 |
| Pregnancy after operation— | | |
| Traceable cases | 45 | 14.0 |
| Pregnancy occurred in | | |
| Total pregnancies in 45 cases | 69 | |
| Pregnant at time of follow up | 4 | |
| Tubal pregnancy | 3 | |
| Results in remaining pregnancies— | | |
| Normal deliveries | 27 | |
| Abortions | 20 | |
| Miscarriages | 4 | |
| Caesarean delivery | 1 | |
| Breech delivery | 1 | |
| Instrumental deliveries | 9 | |
| Two normal deliveries | 3 | |
| Three normal deliveries | 1 | |
| Two instrumental deliveries | 2 | |
| Examined after childbirth— | | |
| Uterus in position | 8 | 72.7 |
| Partial recurrence | 3 | 27.2 |
| Recurrence | — | — |

TUBERCULOSIS SALPINGITIS (CONSERVATIVE
OPERATIONS)—22 CASES

| | Cases | Per cent |
|---------------------------------------------|-------|----------|
| Untraceable | 6 | 27.2 |
| Traceable more than 2 years after operation | 8 | 36.3 |
| Examined more than 1 month after operation | 13 | 59.0 |

Examined 2 or more years after operation

| | Cases | Per cent |
|---------------------|-------|----------|
| Operative mortality | — | 9.0 |

Gross results from all follow ups—

| | | |
|-----------------------------------------------------------------------|----|------|
| Symptomatic— | | |
| Cured | 12 | 75.0 |
| Relieved | 3 | 18.7 |
| Failure | 1 | 6.2 |
| Anatomical position of uterus (examined)— | | |
| In position | 11 | 84.6 |
| Partial recurrence | 2 | 15.3 |
| Recurrence | — | — |
| Results based on follow ups of more than 2 years— | | |
| Symptomatic— | | |
| Cured | 6 | 75.0 |
| Relieved | 2 | 25.0 |
| Failure | — | — |
| Anatomical position of uterus (examined)— | | |
| In position | 1 | 50.0 |
| Partial recurrence | 1 | 50.0 |
| Recurrence | — | — |
| Pregnancy after operation— | | |
| Definitely known | — | — |
| One patient 11 months after operation wrote she was 9 months pregnant | | |

MULTIPLE FIBROIDS (MYOMECTOMY)—33 CASES

| | Cases | Per cent |
|---------------------------------------------------|-------|----------|
| Untraceable | 5 | 15.1 |
| Traceable more than 2 years after operation | 14 | 42.4 |
| Examined more than 1 month after operation | 23 | 69.6 |
| Examined 2 years or more after operation | 6 | 18.1 |
| Operative mortality | — | — |
| Gross results from all follow ups— | | |
| Symptomatic— | | |
| Cured | 19 | 73.0 |
| Relieved | 4 | 25.3 |
| Failure | 3 | 11.5 |
| Anatomical position of uterus (examined)— | | |
| In position | 17 | 80.9 |
| Partial recurrence | 2 | 9.5 |
| Recurrence | 2 | 9.5 |
| Results based on follow ups of more than 2 years— | | |
| Symptomatic— | | |
| Cured | 9 | 64.2 |
| Relieved | 3 | 21.4 |
| Failure | 2 | 14.2 |
| Anatomical position of uterus (examined)— | | |
| In position | 3 | 50.0 |
| Partial recurrence | 2 | 33.3 |
| Recurrence | 1 | 16.6 |
| Pregnancy after operation— | | |
| Total patients | 4 | |
| Pregnancies in 4 cases | 8 | |
| Normal deliveries | 5 | |
| Abortion | 1 | |
| Pregnant at time of follow up | 2 | |
| Cured | 4 | |

OVARIAN TUMORS—86 CASES

| | Cases | Per cent |
|---------------------------------------------------------|-------|----------|
| Untraceable | 15 | 20.9 |
| Traceable more than 2 years after operation | 51 | 59.3 |
| Examined more than 1 month after operation | 43 | 50.0 |
| Examined 2 or more years after operation | 14 | 16.3 |
| Operative mortality | 2 | 2.3 |
| 1 30 years of age pneumonia 3 days after operation | | |
| 2 60 years of age surgical shock 3 days after operation | | |
| Gross results of follow up— | | |
| Symptomatic— | | |
| Cured | 54 | 77.1 |
| Relieved | 15 | 21.4 |
| Failure | 1 | 1.4 |
| Anatomical position of uterus (examined)— | | |
| In position | 37 | 66.0 |
| Partial recurrence | 5 | 11.6 |
| Recurrence | 1 | 2.3 |
| Results based on follow ups of more than 2 years— | | |
| Symptomatic— | | |
| Cured | 36 | 70.5 |
| Relieved | 14 | 27.4 |
| Failure | 1 | 1.9 |
| Anatomical position of uterus (examined)— | | |
| In position | 8 | 57.1 |
| Partial recurrence | 5 | 35.7 |
| Recurrence | 1 | 7.1 |
| Pregnancy after operation— | | |
| Traceable cases | 9 | 13.2 |
| Pregnancy occurred in | | |
| Total pregnancies in 9 cases | 15 | |
| Pregnant at time of follow up | 1 | |
| Results in remaining pregnancies— | | |
| Normal deliveries | 8 | |
| Abortions | 4 | |
| Instrumental deliveries | 2 | |
| Examined after childbirth— | | |
| Uterus in position | 2 | 100.00 |
| Partial recurrence | — | — |
| Recurrence | — | — |

ENDOMETRIOSIS—26 CASES

| | Cases | Per cent |
|---------------------------------------------|-------|----------|
| Untraceable | 4 | 15.3 |
| Traceable more than 2 years after operation | 13 | 50.0 |
| Examined more than 1 month after operation | 15 | 69.2 |
| Examined 2 or more years after operation | 7 | 26.9 |
| Operative mortality | — | — |
| Gross results from all follow ups— | | |
| Symptomatic— | | |
| Cured | 13 | 59.0 |
| Relieved | 6 | 27.2 |
| Failure | 3 | 13.6 |
| Anatomical position of uterus (examined)— | | |
| In position | 14 | 77.7 |

| | Cases | Per cent |
|---------------------------------------------------|-------|----------|
| Partial recurrence | 3 | 16.6 |
| Failure | 1 | 5.5 |
| Results based on follow ups of more than 2 years— | | |
| Symptomatic— | | |
| Cured | 9 | 69.2 |
| Relieved | 1 | 7.6 |
| Failure | 3 | 23.0 |
| Anatomical position of uterus (examined)— | | |
| In position | 6 | 83.3 |
| Partial recurrence | — | — |
| Recurrence | 1 | 14.3 |
| Pregnancy after operation— | | |
| Normal pregnancy and delivery (cured) | 1 | |

TUBAL PREGNANCY—25 CASES

| | Cases | Per cent |
|---------------------------------------------------|-------|----------|
| Untraceable | 9 | 36.0 |
| Traceable more than 2 years after operation | 11 | 44.0 |
| Examined more than 1 year after operation | 11 | 44.0 |
| Examined 2 years or more after operation | 3 | 12.0 |
| Operative mortality | — | — |
| Gross results from all follow ups— | | |
| Symptomatic— | | |
| Cured | 13 | 52.0 |
| Relieved | 2 | 12.5 |
| Failure | 1 | 6.2 |
| Anatomical position of uterus (examined)— | | |
| In position | 10 | 60.0 |
| Recurrence | 1 | 9.1 |
| Failure | — | — |
| Results based on follow ups of more than 2 years— | | |
| Symptomatic— | | |
| Cured | 10 | 60.0 |
| Relieved | — | — |
| Failure | 1 | 9.1 |
| Anatomical position of uterus— | | |
| In position | 3 | 100.0 |
| Partial recurrence | — | — |
| Recurrence | — | — |
| Pregnancy after operation— | | |
| 1 pregnant | 3 | |
| 1 pregnancies in 3 | 5 | |
| Second tubal pregnancy | 2 | |
| Abortion two normal pregnancies and deliveries | 1 | |
| Cured | 3 | 100.00 |

SUMMARY OF ALL STATISTICS

| | Cases | Per cent |
|---------------------------------------------|-------|----------|
| Total number of cases | 3358 | |
| Untraceable | 519 | 17.2 |
| Traceable more than 2 years after operation | 1758 | 52.3 |
| Examined more than 1 month after operation | 1980 | 58.9 |
| Examined 2 or more years after operation | 533 | 15.8 |
| Operative mortality | 15 | 0.446 |
| Peritonitis | 5 | |
| Pneumonia | 3 | |
| Pulmonary embolism | 5 | |

| | Cases | |
|----------------------------------------------------------------------------------------------------|-------|----------|
| Surgical shock | 2 | |
| Pelvic abscess | 1 | |
| Cerebral embolism | 1 | |
| Under anaesthesia | 1 | |
| Intestinal obstruction | 1 | |
| Gross results from all follow ups in 2764 traceable cases— | | |
| Symptomatic— | Cases | Per Cent |
| Cured | 1854 | 68 5 |
| Relieved | 701 | 25 9 |
| Failure | 158 | 5 8 |
| Anatomical position of uterus (examined)— | | |
| In position | 1696 | 83 4 |
| Partial recurrence | 152 | 7 9 |
| Recurrence | 65 | 3 3 |
| Results based on follow ups of more than 2 years— | | |
| Symptomatic— | | |
| Cured | 1177 | 66 8 |
| Relieved | 481 | 27 3 |
| Failure | 100 | 5 6 |
| Anatomical position of uterus (examined)— | | |
| In position | 411 | 76 9 |
| Partial recurrence | 76 | 14 2 |
| Recurrence | 47 | 8 8 |
| Pregnancy after operation— | | |
| Traceable cases | Cases | 2764 |
| Pregnancies occurred in | 489 | 17 6 |
| Pregnancies in 489 patients | | 85 6 |
| Pregnant at time of follow up, outcome unknown | | 49 |
| Tubal pregnancies | | 8 |
| Placenta praevia | | 1 |
| Deaths associated with later pregnancy | | 8 |
| Intestinal obstruction 2 months after delivery | | |
| Postpartum influenza—2 cases | | |
| Following dilatation and curettage for retained products | | |
| Placenta praevia with haemorrhage | | |
| Following caesarean section | | |
| During labor—cause unknown | | |
| Puerperal septicæmia | | |
| Results in remaining pregnancies— | | |
| Normal deliveries | 406 | |
| Abortions | 159 | |
| Miscarriages | 38 | |
| Premature deliveries | 14 | |
| Breech deliveries | 9 | |
| Caesarean deliveries | 42 | |
| Instrumental deliveries | 132 | |
| In all 575 living normal children were born to the group of 489 patients who had later pregnancies | | |
| Examined after childbirth— | | |
| Uterus in position | 95 | 71 4 |
| Partial recurrence | 17 | 12 7 |
| Recurrence | 21 | 15 7 |

These 489 patients comprise 21 2 per cent of all the traceable patients in the series that were under the age of 45 at the time of operation and consequently were in the childbearing age

LATER DEATHS

As has been stated, the mortality records at the Massachusetts State House were searched in order to obtain information not in the Hospital records regarding later childbearing and intestinal obstruction. Since the deaths from causes other than these two have no special bearing on the subject of the Olshausen's operation, they will not be given in detail in this report. The mortality figures relating to childbirth are given above in the summary of statistics. The incidence of intestinal obstruction follows

INTESTINAL OBSTRUCTION

There are in all 6 cases known to have had intestinal obstruction. Of these, 2 died without operation. Of the 4 that were operated upon, 3 survived and are living today. Whether or not the obstruction was in every case due to the Olshausen's operation it is impossible to say.

The data of the 6 cases are as follows

- 1 Pelvic Inflammation 22 years old. Second operation at Free Hospital for Women. Survived.
- 2 Antelexion and Retrocession. Obstruction followed childbirth 1 year and 6 months after operation. Patient died. Reported above as childbirth death.
- 3 Retroversion. Operation for obstruction done else where. Patient is well and writes "No fault of first operation."
- 4 Prolapse 38 years old. Died 4 days after prolapse operation at Free Hospital for Women. No second operation. Reported above as operative death.
- 5 Prolapse 46 years old. Operated on for obstruction 46 days after prolapse operation and died.
- 6 Prolapse. Later "operation for adhesions which caused stoppage." Recovery. Well 6 years and 1 month after prolapse operation.

POSTOPERATIVE HERNIA

There were 41 cases of postoperative hernia, an incidence of 1 47 per cent in the followed cases. Ten hernias developed in less than 1 year after operation, 21 appeared in less than 2 years. The rest were late developments. Most of the hernias occurred in multiparous women with weak abdominal walls.

SILK STITCH SINUS

A silk stitch sinus occurred in 45 cases, an incidence of 1 34 per cent. Nineteen occurred in the pelvic inflammation group, 9 in the retroversion, and 14 in the prolapse groups. We have abandoned the use of silk in favor of catgut.

EDITORIALS

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MAY, 1931

PERSPECTIVE

AN extraordinary development of laboratory methods has come to the aid of clinical diagnosis, but the enormous amount of detailed information which has accompanied this growth has resulted in some confusion in medical practice.

The proper practice of medicine must include wide knowledge of clinical diagnostic methods and some skill in the manipulation of such instruments of precision as have won their way to standing in the medical profession. Although this new development makes essential an understanding of laboratory examinations and their application to individual patients, knowledge of the details of the methods themselves is not so essential. It is important that the practitioner should relate the history, symptoms, and laboratory investigations to the clinical condition of the patient, but machine methods should not be allowed to take the place of clinical investigation. It might be said that a good clinical investigator uses the laboratory as an aid but is not controlled by it.

In teaching young men, we should insist that in clinical examinations they first record a résumé of the patient's history, including symptoms. Then a general physical examination should be made with the aid of common instruments of investigation, that is, with the stethoscope, speculums, and the microscope, to such an extent as the practitioner should be able to use them. Next, the tentative clinical diagnosis should be written down before the patient is sent on a round of laboratory tests. Sometimes it is difficult to prevent the well trained young physician from sending the patient for laboratory investigation after a cursory clinical examination. A man on a fellowship, a well trained young physician and now one of the best, after making a fairly complete clinical study, gave the patient a card ordering roentgenographic examination of his teeth. The patient at once reached into his mouth, pulled out two complete plates of teeth, and asked "When can I have them back?"

To illustrate just what perspective means, if a patient comes in with a definite history of gall stone disease, it is not so important to make roentgenographic examination as it is to make a careful general physical examination to learn whether there is good reason why an operation should not be performed. Frequently patients give a clear clinical history of gall stone disease, but a negative roentgenographic report is received, and the physician on that account advises against an operation which he would have advised if the cholecystographic report had given positive indication of disease. Papillomatosis of the gall bladder, cholesterosis, and other conditions unaccom-

panied by stones may not give definite roentgenological evidence of their presence unless the picture is taken during an attack in which inflammatory swelling has produced obstruction of the cystic duct. Yet these conditions are just as essentially surgical as they are in those cases in which the roentgenogram gives evidence of stones or of a non-functioning gall bladder.

Too great dependence on roentgenological evidence may be misleading in the diagnosis of duodenal or gastric ulcer. The extraordinary efficiency of the roentgenologist in the diagnosis of duodenal or gastric ulcers sometimes leads to overemphasis on the importance of the roentgenological examination. Probably 5 per cent of ulcers of the stomach and duodenum will not give evidence of their presence on roentgenological examination, sometimes not even in a series of exposures. However, if the clinical history is complete and if clinical methods of examination have given evidence of the presence of ulcer, a negative result of roentgenological examination should not lead to the belief that ulcer is not present.

In acute conditions, such as suspected obstruction of the bowels, the introduction of opaque mixtures for the purpose of radiographic examination may increase the blocking at the obstructed portion. In such cases the use of spinal anaesthesia will often so relax the intestines that, if the obstruction is not mechanical, flatus usually will pass within 20 minutes. If flatus does not pass, the diagnosis of obstruction is probable, the patient is already under an anaesthetic, and the necessary operation can be carried out at once. In intestinal obstruction general anaesthesia is dangerous, local abdominal wall block anaesthesia is the choice. Even if the stomach is carefully emptied immediately before opera-

tion, reverse peristalsis may set in, carrying the liquids up into the pharynx, where they may be inhaled into the lungs, the result may be septic bronchitis, from which the patient may die in the course of a week or 10 days, or the patient may even drown on the operating table.

It sometimes happens after an abdominal operation that a patient may begin to give evidence of possible intestinal obstruction. This is an anxious time for the surgeon, because he does not know that obstruction actually exists. In such a case, spinal anaesthesia may give the answer. If symptoms are not promptly relieved, the abdominal incision can be reopened, and manual examination can be made. If this is done within 72 hours after the original operation, and adhesions or kinking, the result of the operation, are causing the obstruction, they can be readily separated. Under such circumstances, when I have found and relieved this form of early acute obstruction, I have brought the intestine up to the abdominal incision at a point just proximal to the obstructed part and have fastened a small portion of it to the peritoneal surface by a few threads left long, so that ileostomy could be readily done later if the obstruction were not relieved. However, it has been exceedingly rare that ileostomy has been necessary. If the favorable time of the fourth day is allowed to go by, and obstruction exists, the adhesions usually cannot be separated readily with the fingers without injury, and more serious procedures must take the place of this simple, effectual, and safe procedure. In late obstruction in a toxic patient local anaesthesia is safer than spinal anaesthesia, Counsellor points out the rapid lowering of blood pressure which sometimes follows spinal anaesthesia in such cases.

W J Mayo

APPENDICITIS ONCE MORE

THE reason for the high mortality of acute appendicitis is not far to seek. It is a disease the death rate of which increases with each hour that surgical relief is deferred. Yet patients with acute appendicitis are still being treated expectantly, not as a matter of policy, but because the medical attendant—who is not always the much maligned general practitioner—has no fixed conviction about his diagnosis. Now this is not the expectant treatment advocated by Fowler, Ochsner, Murphy, and Deaver, and advocated by them, be it remembered, not as a matter of choice in primary appendicitis, but as a matter of expediency in secondary peritonitis. Whether we approve of the policy of expectant treatment in advanced cases of appendicitis is not germane to this discussion. The point is that even its most ardent champions do not advocate it for early cases. There can be no discussion of the dictum that the first stage of the disease, as Murphy puts it, is the acceptable time for salvation and likewise the time for removing the appendix.

Knowing this, believing this, why do physicians delay? Again the reply is obvious. They delay because in the majority of cases the diagnosis is clouded by the fact that the so-called classic syndrome is not present. Appendicitis without abdominal pain—though not at first right-sided pain—is unthinkable. But after pain the symptoms and the physical findings always vary in their incidence and in their combinations. "The only hand that paints a perfect pathological picture," it has been well said, "is the hand of death," and the only safety in appendicitis is diagnosis before that perfect picture is painted. The internist who diagnoses acute appendicitis, the surgeon who operates for it only when the full complement of symptoms is apparent, may achieve envi-

able reputations for diagnostic acumen, but their fame will be chiefly in the autopsy room, for they will have few living patients to their credit.

This is a disease in which operation is justified on the mere suspicion that it exists. A hair splitting diagnosis, as Deaver aptly says, rarely gets a surgical patient anywhere except possibly to the grave, and the best authorities are agreed that exploration in suspected surgical conditions is always less harmful than delay, and that a few unnecessary incisions into a live patient are infinitely better than a single autopsy on a dead one.

Of course the medical profession is not altogether to blame. Some day some physician is going to lose his temper and write a paper on the responsibility of the public for its own death rate. The salvation of the individual suffering from acute appendicitis undoubtedly depends above everything else upon the promptness with which he obtains relief—but relief cannot be given to him until he applies for it and until he accepts it. Surgeons cannot force people to consult them, they cannot operate on them against their wills, and the group "opposed to operations" and swallowing with avidity old wives' tales of their horrors is still surprisingly large and is composed of a surprising number of persons one would be inclined to credit with more common sense.

The chief activity of lay persons engaged in the business of self treatment is the taking of purgatives, and a purgative in acute appendicitis has all the effect of a charge of dynamite. It practically always initiates rupture, gangrene, abscess formation, and peritonitis. It practically always, as Moynihan says, is not only the impressive antecedent of such pathology but also its definite cause.

In a recent study made by the writer¹ of 230 deaths from acute appendicitis, collected from

the records of Charity Hospital and Touro Infirmary in New Orleans, more than 42 per cent of the patients gave a history of having taken purgatives, and in this group of 103 cases, only 2 patients exhibited disease of the simple acute type. An extraordinary fact in connection with these figures is that many more patients, 17 per cent more, to be exact, had treated themselves in this fashion at the private hospital than had done so at the public hospital, where presumably a lower level of intelligence would prevail. And a second astounding fact is that in 12.6 per cent of these cases the purgative was taken on the advice of the medical attendant. Before such a situation one is rather aghast. For physicians must know, even if lay persons do not, that abdominal pain can be the precursor of many serious surgical diseases, and that it is most often the precursor of acute appendicitis, in which purgation is akin to suicide.

Appendicitis is perhaps the best known of all diseases. It is beyond doubt the best known of all surgical diseases. In its typical syndrome it is so clearcut that the intelligent lay person can diagnose it, in its earliest stages it is so simple that a beginner in surgery can handle it. But in the vast majority of cases it begins with symptoms which do not suggest the popular, or, most unfortunately, the medical conception of it, and in a large proportion of cases it never presents the classic syndrome at all or until the patient is *in extremis*. For this reason it is ignored by the laity and misunderstood by the profession, and treated by both groups by ill-advised and dangerous methods which double the dangers of delay. When it has passed beyond its first stages it offers problems of judgment and technique which tax to the utmost the resources of expert surgeons, and yet, because it is supposed to be a simple disease and because appendectomy is supposed to be a simple operation, the merest

neophyte in surgery feels himself competent to handle it.

The remedy is simple. The laity must be educated out of its pernicious habit of self-medication, must be taught that abdominal pain is the most urgent of all indications for refraining from purgation. And the profession might well be taught the same thing, for some of them seem to have forgotten it. Physicians might well be taught also that the textbook syndrome of appendicitis is too often the syndrome of the consequent peritonitis, and that when it appears, the patient's life hangs in the balance and surgery should be the business only of the trained and experienced and wise surgeon. More than one authority of eminence has made the point that much of the present mortality in appendicitis, as in other surgical diseases, is due to the occasional operator and to the license which permits him to wield the knife when his chief qualification is simply his desire to do so.

Laity and profession alike must be taught that the major factor in the mortality of appendicitis is the factor of delay, and that only by the reduction of the interval between the onset of symptoms and the institution of surgical relief—the length of the interval being the responsibility of the medical attendant as well as of the patient—can it be brought within reasonable limits. Surgical accidents are bound to occur, certain cases are inherently fatal, and so some patients will inevitably die, no matter how early operation is done. But the patient who is operated on within 12 or even within 24 hours will in the overwhelming majority of cases go on to recovery, and to uncomplicated recovery at that, for the outcome of any given case of appendicitis rests not upon chance but upon the promptness with which the patient seeks relief and the promptness with which the surgeon institutes it.

C. JEFF MILLER

CORRESPONDENCE

DIAGNOSIS OF CONTRACTED PELVIS BY IMPRESSION METHOD

To the Editor In SURGERY, GYNECOLOGY AND OBSTETRICS, December, 1930, p 852, Dr David S Hillis gives his views on the diagnosis of contracted pelvis by impression method. For several years I have been practicing a method which is a modification of Mueller's method and is quite painless.

With the patient lying flat on her back on a firm couch and the examiner standing at her side, the fetal head is palpated and the tips of the index and middle fingers of one hand are applied firmly to the sacrum and the tips of the corresponding fingers of the other hand firmly to the occiput. The patient is then assisted by the nurse to sit up when the head can be felt to enter the brim (if normal conditions appertain) sliding past the examining fingers. When the patient is assisted to lie down again the *status quo ante* is resumed. It is very interesting to note in cases of 'deflexion' of the head how the head in "borderline" cases will not enter the brim whereas when proper flexion has been restored by maneuver the head readily enters. J LEON JOSEPH D Sc Melbourne, Australia

AN HISTOLOGICAL STUDY OF THE PERIVAGINAL FASCIA IN A NULLIPARA

To the Editor In your journal of January, 1931, there appeared an interesting and scientific article by Dr Byron H Goff entitled 'An Histological Study of the Perivaginal Fascia in a Nullipara'.

While I am in accord with its substance I find myself greatly to my surprise depicted as being out of accord and it is to correct this impression that I am sending you this communication.

The introductory paragraph of the article mentioned contains the following sentences: "Some contend that there is a layer of fascia between the wall of the vagina and the walls of the urethra, bladder and rectum. They believe that obstetric injury to this fascia is the fundamental cause of cystocele, rectocele and urethrocele. Furthermore, when operating for these conditions they demonstrate, by dissecting a layer of pallid tissue several millimeters thick which lies just beneath the vaginal mucosa and term it fascia."

When the bibliography of Dr Goff's article is scanned, the inevitable conclusion is that I believe and teach that the structure of the vaginal wall, utilized by me for the purpose of correcting prolapse of the anterior vaginal wall, is fascia.

My article to which Dr Goff refers in his bibliography was written in 1918 during the very early period of the study of lapping of vaginal tissue for the correction of cystocele and prolapse. Two

years later however, I began to question the accuracy of the view that the tissue used was fascia. I then had microscopic studies made of the vaginal wall tissue removed during operations. My conclusions, as the result of these studies, were published in 1929, in the April issue of your journal. The title of this article was "Fascia Lapping as Applied to the Tissues of the Vaginal Wall—A Misnomer." In this article I distinctly stated that the vaginal tissue utilized in the lapping technique for the cure of cystocele or prolapse is not fascia but muscle and that, as no fascial layer can be demonstrated in this tissue, the term "fascia lapping" is a misnomer.

However, if Dr Goff's article aids (and I think it will) in the crusade of making the gynecologist appreciate and teach the fact that the tissue of the vaginal wall, utilized in the lapping technique for the cure of cystocele is not fascia but muscle, no one will be more pleased than I am.

NEW YORK NEW YORK DOLGAL BURSILL
January 29 1931

AMERICAN PHYSICIANS ARE WELCOME IN THE HUNGARIAN CLINICS

To the Editor A few months ago there appeared in the American press several articles stating that American physicians were no longer welcome in the Hungarian clinics and that the privilege of allowing Americans to enroll as postgraduate students had been withdrawn.

Just at this time an editorial of mine on "Hungarian Surgery" appeared in SURGERY, GYNECOLOGY AND OBSTETRICS and since then I have received so many letters with regard to the matter, I should like to reiterate here that a genuine and sincere welcome awaits the American surgeons in the clinics of Budapest and to deny the veracity of the remarks that so garbled the true state of affairs. American physicians are most cordially received as visitors and as postgraduate students. As to permitting the performing of operations by students and inexperienced surgeons the Hungarian surgical profession must protect itself and its people, just as is done by the profession in our own country.

May I not take this occasion again to urge the American doctor visiting the European clinics to continue his travels a few hours east of Vienna to the beautiful old world capital of Hungary—Budapest—a city of rare charm and delightful people—a city having a wealth of clinical material and a galaxy of distinguished surgeons and medical men teaching the undergraduate and postgraduate students.

DONALD GUTHRIE MD

Sayre, Pennsylvania



EDMOND SOUCHOY
1841-1924

MASTER SURGEONS OF AMERICA

EDMOND SOUCHON

ON August 5, 1924, Dr. Edmond Souchon, emeritus professor of anatomy and clinical surgery in the Medical School of the Tulane University of Louisiana, came to the close of a long life of great activity and distinguished service.

Dr. Souchon was a native of Louisiana and his professional life is intimately associated with the medical history of his state as an anatomist, surgeon, sanitarian, medical educator, and contributor to the literature and technical advancement of his profession.

Edmond Souchon was born in Opelousas, Louisiana, on December 1, 1841. His father, Dr. Eugene Souchon, and his mother, Caroline (Pettit) Souchon, were both natives of France. His earliest schooldays began at St. Martinsville, Louisiana, but at the age of 12 years his parents moved to Mobile, Alabama, and thence to New Orleans, where he studied in private schools. Owing to his father's ill health and reverses of fortune he was obliged to continue his education in the public schools under great disadvantage, to the extent of selling newspapers to aid in the support of the family. With his father's improving health the financial distress of the family was relieved, and the boy was sent to France to continue his collegiate preparation for a medical career.

A studious and ambitious pupil, he made rapid progress, and in 1860 matriculated in the École de Médecine of the University of Paris. With the outbreak of the Civil War at home his allowance ceased, and he was put on his own resources to meet his living and college expenses for the following 4 years. Urged by the spur of necessity he proved his mettle by passing a grilling *concours* for the internship of the Paris hospitals, standing fourth in a list of three hundred and fifty competitors, with the distinction of *Laurent*. He was admitted as a resident at the *Charité*, in the service of Velpeau, the most conspicuous surgeon in the Paris of that day.

It was there that Dr. Souchon first met Dr. J. Marion Sims, who was to be one of the two great friends of his life. Dr. Sims was then an obscure American physician who had had the temerity to cross the Atlantic to teach the great intellectuals and masters of surgery in Paris how to cure vesicovaginal fistula. Dr. Souchon acted as his interpreter and assistant, and becoming aware of his young friend's financial distress, Dr. Sims aided him over the most critical period of his

student career Dr Souchon's gratitude and admiration for Marion Sims is revealed in his "Reminiscences of J Marion Sims in Paris" and "The Places Made Famous by Marion Sims in Montgomery, Alabama "

His father's death hastened his return to the United States, and he came back to New Orleans and received the degree of medicine from the Medical Department of the University of Louisiana in 1867

A letter of introduction from Dr Sims to Dr T G Richardson, then professor of anatomy and clinical surgery, marked a second epoch in Dr Souchon's life He assisted Dr Richardson in private practice, and became his prosecutor and chief of clinic at the Charity Hospital How deeply and tenderly he cherished Dr Richardson's favor and friendship is shown in his "Reminiscences of Dr T G Richardson "

In 1872, Dr Souchon became demonstrator of anatomy in the Medical Department of the University of Louisiana, and served for 4 years In 1885, he was elected professor of anatomy and clinical surgery and filled this chair for 23 years While professor of anatomy he laid the foundation for the Museum of Anatomy, now known by his name, which is entirely representative of his anatomical handicraft It contains over 400 dissections, admirably preserved by original methods of injection and coloration, described in the *Anatomical Record*, Philadelphia

As a teacher of anatomy his chief aim, like that of all his predecessors and contemporaries, was to teach human anatomy in its practical applications to the needs of the practitioner of medicine He viewed the subject from the standpoint of what was most useful in the interpretation of function, disease, and injury in the light of the progress accomplished in his day The importance that he attached to method and system in study is everywhere apparent in his work These fundamental ideas are especially conspicuous in his "Plan for a Methodically Written Textbook of Anatomy," in his "Guide for Describing an Organ," in papers on "How to Learn and Remember Anatomy," and in his surgical teachings, as exemplified in his papers on the "Methodic Description of a Surgical Disease" and "Method of Reporting a Surgical Case "

In surgery he was essentially an operator of the anatomical era He naturally excelled in all operations which required a knowledge of anatomy and in this he was soon recognized and quickly acquired an independent and lucrative practice It was his ability as an anatomist that led to his association with Dr Andrew Smyth, the eminent surgeon in chief of Charity Hospital, in connection with the historic case of Banks, the negro patient, whose innominate artery Dr Smyth successfully ligated for aneurism for the first time in surgical history This case stimulated Dr Souchon to pursue his studies on aneurism, and later on dislocations of the shoulder joint His many monographs on these subjects will remain conspicuous landmarks in the history of these subjects and are undoubtedly the most enduring literary monuments of his surgical career

In addition to the exacting demands of a large clientele he found time to give expression to his thoughts and ideas in a large number of publications, which, up to the last years of his life, kept pace with his diversified activities and reflected the working of his busy mind.

In 1898, Dr Souchon was elected president of the State Board of Health of Louisiana, and held this position for 7 years, leaving a record of efficiency and accomplishment. With this election he entered into an entirely new phase of his medical experience, which gave him ample opportunity to use the executive and administrative talents which he naturally possessed.

He prepared a sanitary code which is now regarded as the most complete and useful guide to the health laws and sanitary regulations of the state. He contributed actively in framing the "Atlanta Regulations," adopted by the Southern States in 1898, thereby greatly alleviating the burdens of quarantine imposed upon the commerce of the South whenever yellow fever broke out in any community.

In addition to his official and professional titles, Dr Souchon held many other positions of distinction and responsibility. He had been president of the New Orleans Medical and Surgical Association, president of the Orleans Parish Medical Society, vice president of the American Medical Association, fellow of the American Association of Anatomists, fellow of the American Surgical Association (1895-1924, vice-president 1899), honorary fellow of the American College of Surgeons, corresponding member of the Société Nationale de Chirurgie de Paris (since 1900), chairman of the medical committee of the board of administrators of the Charity Hospital (1879-1882), and member of numerous other organizations.

Much could be said of his personal characteristics, which were those of a man of very positive opinions and convictions, but the two dominant traits that overshadowed all others were his passion for *punctuality* and method. Though seemingly unsentimental at times and with his attention wholly engrossed in the business at hand, he was capable of great outbursts of enthusiasm and expression. His loyalty and devotion to Marion Sims and Richardson, who had befriended him in his struggling youth, will always be quoted by those who knew him as proof of the undying quality of his friendship and affection. His domestic life was ideal. His happiness centered in the family circle, with the companionship of his wife and children as the *summum bonum* of his existence.

RUDOLPH MATAS

THE SURGEON'S LIBRARY

OLD MASTERPIECES IN SURGERY

ALFRED BROWN, M.D., FACS OMAHA

WILLIAM OF SALICET

DURING the thirteenth and fourteenth centuries the surgeons of importance far outnumbered the practitioners of internal medicine. Even the men who had graduated in medicine and made more or less of a name for themselves in their later and more mature years turned to surgery until the list of great surgeons of that period is a long and pretentious one. The explanation may be offered that the period was that of the list of the crusades and because of war and its wounds the medical mind veered to surgery. This explanation however does not seem to satisfy completely, as wounds were comparatively few and could not entirely dominate the scene. Moreover many men away from home in a hot country to which they were strangers, must have presented problems of sanitation and preventive medicine which could fully occupy the time of many medical men. Also if war surgery had dominated the picture the surgeons would certainly have written of their cases and results but it is surprising how few specific references to war surgery and its results are found in the writings of the surgeons of the period. The above explanations failing to answer the question fully the reason as all reasons must be sought for in a state of mind in other words the practice of surgery was probably intellectually more satisfactory than that of medicine.

A glance at conditions in internal medicine at this time will tend to confirm this idea. The Hippocratic and Galenic doctrines, altered somewhat by the views of the Arabians held full sway but whereas these ancients had cast aside the supernatural and magical and come down to realities these influences had come back with vigor renewed after their long absence and overshadowed all else. This was particularly true in the line of treatment. Astrology was the most important of the forms of godly intervention and control over human life. The medical men wrote long dissertations on the influence of the heavenly bodies upon disease and its treatment. Petrus de Abano one of the most famous internalists of this time, says that the critical day in an illness was influenced greatly by the phase of the moon. That bleeding is best performed in the second quarter of the moon because its light was then waning to its greatest and hence the power of the moon was greatest. That to cure renal colic the best treatment was to draw a picture of a lion on a gold platter and

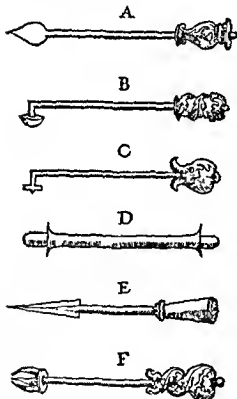
hang it up when the sun passed across the meridian in company with Regulus. One can easily imagine that with this type of medical practice the man of ordinary intelligence might turn to surgery.

William of Salicet also known as Master Placentinus from his birth place Placentia was one of these. He was born about 1210 and lived and taught in Bologna the greater part of his life. In his later years he became city and hospital physician in Verona and finished his surgery in that town in 1275. He says he started it in Bologna four years before, at the request of Rufino the Prior of Saint Ambrogio in Vicenza. The work was first printed in 1476 at Piacenza and went through many reprints both separately and in collections. The reproduction here given is taken from a collection called *Arts Chirurgicae* headed by the surgery of Guy de Chauliac and printed at Venice by the Junta press in 1546. The illustration shows some of the cautery irons used by William, which evidently follow the designs of Albucasis.

Placentinus was primarily an operating surgeon and followed the school of Roger and Roland. Unlike the surgeons of a little later period he did the operating himself and did not leave it to laics who followed his directions. In this he was quite advanced for he was a cleric and was one of the first of the Italian surgeons to break away from the religious dictum that the Church abhors blood. The authority for saving he operated himself is found in his introduction where he says "And therefore, it is proper on this account in this part of the doctrine to proceed according to those things which have been manifested to me for a long time through practice and operation and by examples which in many cases are limited to discourse but in my examples and discourses I have labored with my hands themselves." William of Salicet appears to be greatly interested in the surgery of the head. He describes hydrocephalus which he treated at first by inunctions of sulphur ointment and later with the cautery. He was somewhat of an investigator for he tried to outline the sutures of the cranium by staining them with color. In skull injuries he preferred to use the chisel rather than trephine and advises extreme caution in the use of the latter. Probably the most important observation made by William of Salicet was that ulcers of the genitalia were transmitted by direct contact. He did not recognize the significance of the ulcer as part of a generalized disease but knew that it occurred and was contagious.

CHIRURGIVS CVLIELMI

per melius, ut ipsa omnia instrumenta ad vi redacta
figuras & formas, quia eū illis oia cauteria ad infirmi-
tates membrorum quascūq; vili cōmode fieri poterūt
Quocumq; instrumentorū primum est oliuare seu cul-
tellare, quod est valde cōmune instrumentum om-
nibus membris, cuius forma & figura est hæc A.
Secundum, est cauteriū eluale, quod est satis cōe ad
adufiones paruas faciendas vbi cūq; sed solum in
membris minutis & paruis, cuius forma est hæc B.
Tertium est cauteriū punctuale, quod est cōmune
instrumentum ad adufiones oarias faciendas, cui-
us hæc est figura C.
Quartum, est cauterium rotundum, quod est cōmu-
ne cauterium, ne impressiones profundentur in mē-
bro, & nervos lædæ & arterias, & venas, cuius for-
ma est hæc D.
Quintum, est cauterium minutum, seu radiale, qd est
eoc cauteriū pueris, cuius forma & figura hæc est E.
Sextum, est cauteriū triangulatum, qd est proprium an-
thax cauteriū, & pōt fieri quum indigeas multipli-
catione pforationis in loco, cuius forma est hæc, F.



Sciendum est, quod omnis locus, in quo sit dolor, &
nō resoluitur beneficio purgationum, videlicet per
vāctiones seu emplastrationes, potest secure cauteri-
zari & si locus dolorosus fuerit nervosus, ut est ge-
nu aut cubitus vel spina, nō perforetur ibi cum cau-
terio spissitudo rotas ipsius rursus, ne nervus seu arteria,
aut radix nervorū aliqua lædatur. Sed hæc considerā-

tionem cautele & aduertentia habita per medicū soler-
tem, secure omnis locus cauterizetur in spiritalibus
infirmitatibus, sicut in dolore capi-
tis salte materiali sic oliuare seu cutellare cauterium
in loco capitis, in quo terminatur digitus medius ma-
nus qñ radix palmæ manus ponitur sub radice nasi,
& extendit digitus fursum super fronte & debet im-
primi istud cauteriū vsq; per totam spissitudinem cu-
tis, vel locus bene emburatur & vāgus caliditas &
virtus possit vsq; ad profundū pertransire & sub cra-
neo, & cōferri istud cauteriū ad eoryzam & ad catar-
rhum, & ad multiplicationē & humiditatem abundan-
tem in cerebro, & ad dolorem denum & oculorū,
& breuiter ad eōdem ægritudinem quæ accidit possi-
mum cerebro propter frigiditatem & humiditatem eius,
sicut paralytis apoplexia, lethargus, scotomia & hu-
lismodi. sunt & cauteria ex eode cauterio & in eisdē
infirmitatibus qñ primum cauteriū non conserit sup
duo cornua capitis in occipino, & super duo cornua
anteriora, & in illa parte capitis posteriori vbi nūc
onitur. Sed attende qm in isto loco, cauteriū profunde
imprimi non debet, ne nux in partibus nervosis ibi
existentibus, & per cōsequens eoi corpori nocumē-
tum grande inferatur, & debet esse tale cauteriū insti-
tutum rotundū ad modum sigilli, auebuli sunt enī
cauteria cum infro punctali extra radices aurium,
in doloribus a consilia; paritum & sunt & cauteria
cum cauterio minuto vel radiali in palpebris oculo-
rum quum mollificant ex humido superfluo, immo
in illo profunde imprimunt cauteriū huius loci sunt
& cauteria duo cōsimilia ex vtrāq; parte colli dextra
& sinistra, unū quodq; inter nervos colli & aurem, &
G evitantur ex toto ibi venæ & arterie ibi manifestæ
& apparentes & potissimum illa propter lachrymas &
alias ægritudines humidas materiales oculos, & pro-
pter paralytim ex vicio nux factis, et eius ortus possi-
biles sunt & cum in isto cutellari, vel eluali, qm me-
lius est in unico vero cum cauterio punctali, sic cau-
terium punctale vnum propter dolorē humeri cum
cauterio rotundo, sunt cauteria in spina, quæ nō im-
primunt propter multitudinē nervorum & scissus
propter gibbositatem & dolores spinæ, vel renum.
Cum cauterio terotundo sunt tria cauteria in pecto-
re, & specialiter in asthma, & emphyate, & hmoi.
Et sub vmbilico in ore stomachi sunt cauteria cum
cauterio eluali, & imprimunt mē medio. Ad hydro-
psum & colicem, & super hepæ celsplene, sunt caute-
ria eluala & oliuaria, propter oppilationes & eorū
dolores. In inguine vero sunt cauteria minuta ppter
dolores vesicæ & propter colicē, & super caudam
cum eodē infro, vel eluali, propter dolorē illius lo-
ci. Super anetha vero sunt cauteria tria circa nōcumē-
tum eius, cum infro tertio & possunt ex lateribus fie-
ri duo cauteria cum oliuari in eodē loco, propter ean-
dem causam sunt sub genu & in oncauare eius in-
ter illas duas chordas cauteria rotunda seu eluala p-
pter dolorē genu, ex materia ibi præfend aut ppter
cōplexionem frigidā. In plantis vero pedis inter su-
ricularem digitum et anulare, aueinter pollicem &
Indicē pedis sunt, propter dolorem marerialē & pro-
pter podagrā saltem frigidā, cauteria punctuala seu
minuta, & aliqñ cutellaria, sicut in infirmis sunt for-
as aut debiles, aut paucis vel impatis. & sunt huius
modi cauteria per eandē causam in loco domestico
& sylvestri

REVIEWS OF NEW BOOKS

THE book on *Chronic Nasal Sinusitis*¹ by Watson Williams is a treatise on the general manifestations of chronic suppurative nasal sinus disease. It is illustrated with case histories drawn from the author's personal experiences. Focal sepsis is particularly stressed, the theories of Rosenow and Billings and the local immunization theory of Besredka being used. Pathogenesis is discussed fully as pertaining to nasal sinus disease. The author's method of exploratory suction technique whereby a syringe is passed into the sinus to aspirate contents for cultural purposes is described in detail.

J D

EVERY physician knows the frequency and seriousness of burns and yet comparatively little has been written on this important subject. The authors of *Burns* present an excellent monograph to supply this hiatus in the surgical literature. Their material consists in a large part of a resume of what has been written on burns and the reader is given numerous references on any part of the subject which he cares to follow more fully.

The book is well organized. The first part is devoted to the fundamental facts concerning burns and scalds and has a discussion as to the various theories in regard to the etiology of duodenal ulcer in cases of burns and the cause of death from burns. The second part treats of the management of thermal burns. In the preface, the authors state that they have probably not given to the tannic acid treatment space commensurate with its value, and the reviewer agrees with them. They also suggest the advisability of a separate chapter on burns and scalds in children. These additions would add much to any future edition.

In discussing the matter of contractures following burns it might have been advisable to have inserted a paragraph emphasizing the responsibility of the surgeon in preventing these deformities and the imperative necessity of using the proper splinting and extension methods from the earliest possible moment. In part three, regional burns are considered and chapters are devoted to burns produced by such specific agents as electricity, lightning, roentgen rays, radium, chemicals, and war gases. The closing chapter deals with the medico-legal aspect of burns and scalds.

The book is printed in large, readable type and the illustrations are satisfactory. The book should be of great interest to industrial surgeons, it is not unworthy of a place in any surgeon's library.

ALBERT H. MONTGOMERY

¹CHRONIC NASAL SINUSITIS AND ITS RELATION TO GENERAL MEDICINE. By Patrick Watson Williams. New York: William Wood and Company, 1930.

²BURNS: TYPES, PATHOLOGY AND MANAGEMENT. By George T. Pack B.S. M.D. and A. Hobson Davis B.S. M.D. Philadelphia and London: J. B. Lippincott Company, 1930.

THE ninth edition of the well known textbook³ for nurses by De Lee has been completely revised with new illustrations added and the subject matter brought down to date. The author has spared no effort in making the work brief and yet comprehensive enough for its needs. The chapters on anatomy, physiology of labor, and conduct of labor including all operative procedures are well treated with excellent illustrations. While great stress is laid on the conduct of labor as carried out in the modern maternity hospital, the author has not lost sight of the fact that a great many patients are still cared for in their homes and strict rules are laid down for the successful management of such cases.

The chapters on the puerperium, both as regards mother and baby, are excellent. Great emphasis is placed on puerperal sepsis and its prevention, an important subject on which the author has taught and written for many years. The text is well worthy of the writer and embodies his high principles of teaching and practice over a long period of years, it is highly recommended for nurses and teachers of nurses.

E. L. CORNELL

THE new edition of the textbook⁴ of histology by Jordan differs but little from recent ones, in fact, since its beginning the descriptive matter, except for minor changes, has remained in the original pattern and pagination. A little has been done from time to time toward the replacement of unsatisfactory illustrations, but some of the illustrations could still be improved. Since Maximow has published his new book which has superb illustrations it is hoped that Jordan and his publisher will be stimulated to effect a real improvement.

The descriptive material has always been simple, clear, and logical. Certain small parts are slightly prolix. Functional correlations are treated very unevenly, many important organs (e.g., eye, lung, liver, kidney) receiving little or no comment while other problematical organs (e.g., spleen, thymus, pineal body) are allotted nearly a page of discussion. References to current literature are also uneven, the introduction oftentimes of controversial matter of doubtful significance being no less remarkable than the omission of contemporary work of the greatest importance.

The reviewer would not wish to appear too critical of this work, he has used it in his classes almost continuously since the first edition. During this period it has remained probably the most generally useful student text in the English language. If it is to retain this position against current competition a genuine revision of the text and an improvement in the

³OBSTETRICS FOR NURSES. By Joseph B. De Lee, A.M., M.D. 9th ed. Rev. Philadelphia and London: W. B. Saunders Company, 1930.

⁴THE TEXT BOOK OF HISTOLOGY. By Harvey Ernest Jordan, A.M., Ph.D. 5th ed. New York and London: D. Appleton and Co., 1930.

quality of the illustrations will doubtless be necessary
L B A

IN the excellent monograph on *The Pathology of Diabetes Mellitus*¹, pathological findings are correlated with clinical studies. Use has been made of tissue removed surgically, and the author has kept in mind the idea of prevention of diabetes and its complications. As a result the book is concerned almost as much with the living as with the dead and is of as much interest to the internist and surgeon as to the pathologist. A survey of the pathology of diabetes mellitus is timely in view of the altered prognosis made possible by insulin and because of the increasing importance of the complications.

In addition to a review of the major contributions to the subject, the author offers tables of his own and conclusions based on 300 autopsies of cases definitely diagnosed as diabetes. It is significant that arteriosclerosis was observed in every case, regardless of age in which the diabetes had been present for 5 years or more. The early formation of atheromatous plaques is explained on the hypothesis that there occurs a gradual accumulation of lipid derived from lipid laden plasma alter the intima has been made permeable by such conditions as hyperglycemia and acidosis. Modern therapy which has permitted a steady approach toward a normal, balanced diet offers the hope that premature arteriosclerosis can be prevented. In the authors 300 cases uncomplicated coma was the cause of death in 53 and coma associated with sepsis in 38 cases. Of particular importance is the fact that, of 259 cases in which the pancreas was available for study this organ appeared normal in 69 (27 per cent). The various hypotheses that might account for this puzzling finding are discussed. This book will be of value to all who are interested in any phase of diabetes.

WALTER H. ADLER.

THE second edition of *Intestinal Tuberculosis*² by Brown and Sampson is a real contribution to tuberculosis literature. This contribution consists of two extremely important points. First intestinal tuberculosis is the most frequent complication of pulmonary tuberculosis and is present in over half of all cases. Tuberculous enteritis in the past was diagnosed only in cases of far advanced ulceration of the intestines. Likewise the treatment in the past when applied to such cases was universally of no avail. Second this book not only gives a detailed, fairly accurate method of diagnosing early ulceration of the intestines but also gives methods of treatment which in a fair percentage of cases is to say the least helpful.

While a large part of this book is used in itemizing the various steps leading up to the Brown and

¹THE PATHOLOGY OF DIABETES MELLITUS. By Shiel & Warren. M D With a foreword by Elliott J. Joslin. M D. Philadelphia: Lea & Febiger 1930.

²INTESTINAL TUBERCULOSIS: ITS IMPORTANCE, DIAGNOSIS AND TREATMENT: A STUDY OF THE SECONDARY ULCERATIVE TYPE. By LAWRENCE BROWN, M D and HOMER L. SAMPSON. 2d ed. rev. Philadelphia: Lea & Febiger 1930.

Simpson method of diagnosis and treatment, there is enough that is really new to make it necessary that this book be known to every general internist and be a part of the library of every X ray and tuberculosis specialist.

JAMES A. BRITTON.

THE well known *Rose and Carless' Manual of Surgery*³ makes its new appearance in its latest, the thirteenth edition. The crowding into one volume of all of the existing surgical knowledge is a prodigious task. The fact that it is intended for students imposes upon the authors further strictures and limitations. Rigorous judgment in the selection of subject matter and the proper emphasis on the essential as well as the elimination of the superfluous and controversial, are all called into play.

With due regard to the evolution of surgical practice and surgical thought the authors stress the importance of study of the initial symptoms rather than of terminal phenomena. They dwell more upon the laboratory methods of diagnosis than the minute details of operations. The arrangement of the subject matter follows the plan used in the preceding editions. The only innovation is to be found in the addition of a separate chapter on 'Tropical Surgery' written by Sir Frank Lowell Connor.

The textbook, since its first edition in 1893, has been regarded by teachers of surgery, both here and in England as a standard text. After an experience with a number of books the reviewer still feels that Rose and Carless meets the requirements of a surgical text for students perhaps better than any other single work in English.

GEORGE HALLFERN.

THIS first edition by the Master of Rotunda Hospital is in its plan an abridgment of Tweedy and Wrench's *Practical Obstetrics*,⁴ now being edited by the present author. It is rather a text and guidebook of practical midwifery for nurses in hospital, out patient, and private practice than a nurses manual of obstetrics. More responsibility to be borne by the nurse is implied than the American profession generally encourages.

It is too easy to criticize destructively, and one must be cautious in the consideration of a general method such as has been adopted by the author and his predecessors. However the teaching of the nurse's use of a vaginal douche in normal labor where with unruptured membranes there is a septic discharge, before all obstetric operations, for a rigid cervix in uterine inertia, and many other analogous points of advice, will probably not appeal so much to some as to the Rotunda trained. One feels that the described left lateral position for delivery should share some consideration with the merely mentioned dorsal, and that other anesthetics

³ROSE AND CARLESS' MANUAL OF SURGERY FOR STUDENTS AND PRACTITIONERS. By Cecil P. C. Wakeley F.R.C.S. (Eng.) F.R.S. (Edn.) and John H. Hunter M.C. M.Chir. (Camb.) F.R.C.S. (Eng.) 13th ed. New York: William Wood & Co. Company 1930.

⁴PRACTICAL MIDWIFERY FOR NURSES. By Bethel Solomons M.D. F.R.C.I. M.R.I.A. New York and London: Oxford University Press 1930.

at least be named in addition to the repeatedly recommended ether and chloroform. The book has too many splendid points in its presentation in nurses of well tested methods, to be considered anything but a first rate work in its class.

Well illustrated, thoroughly indexed, systematically presented, containing a glossary of terms, this 354 page book will, and justly should find a grateful reception by nurses and their instructors in Great Britain. The exactness of the instructions in general, the explicitness of orders to be carried out in relation to the Rules of the Central Midwives Board (which Rules with notes occupy an appended chapter) will relieve many a "monthly" and "district" nurse of unnecessary worry. The format, characteristic of these publications, is very pleasing.

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THE appearance of a new edition of any internationally employed standard textbook is probably hailed, initially, by a reception more of curiosity than of expectation of magazine like timeliness of its material. However, when one turns to the bibliography of a chapter on pregnancy tests in a 1,157 page text and finds there a foreign reference to Aschheim, dated 1930, he experiences a sensation of acclaim in appreciation of an author's efforts and his publisher's achievements. Such an up to date ness is necessary, however, in the case of Whitridge Williams,¹ who, as an acknowledged world leader in the campaign of obstetric conservatism, must be ready with his ammunition to aid in the universal drive for safer expectant motherhood.

The new pages from physiology, anatomy, and pathology to the toxemias, anaesthetics, liver therapy, and low caesarean, bear witness to the thoroughness of the revision of this edition. The statement of the author, claiming that scarcely a page remains unchanged, appears valid when editions are compared. The book is a careful balance between the necessary didactic—the result of the author's teaching experience—and the practical—the outcome of 36 years' obstetric practice.

It is said that in 1903, when the first edition was being prepared, Dr Williams submitted his manuscript to a colleague in the college English department, to edit grammatically. The present volume, similarly, could be used as a working manual of good usage. To the profuseness of illustrations have been added forty plates, distinguished by the photographic quality attained by Max Broedel. The new format adopted, evidences complete resetting and retying, the sheets being larger, the lines longer, the pages more legible.

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THE author of *Aphasia in Children*,² a psychologist who conducts a speech clinic at Manchester,

England, encountered 10 children who were sent to him under the label of "congenital aphasics." On closer examination it was found that 6 of them "suffered from a condition of partial deafness hitherto unknown and unstudied." This condition is called "high frequency deafness."

The traditional methods of testing hearing, we are told, are unsuitable for an analysis of high-frequency deafness. The tuning forks which are the standard instruments for such hearing tests register, in their clinical routine application, only the frequencies from 64 to 256 vibrations per second. Within this range the hearing of the "aphasic" children showed no defect. The defect came to view only when frequencies from 512 to 8,192 were applied. Besides the vibratory frequencies, the intensity steps must be taken into account.

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A modification of the phonograph audiometer, specially designed by the author, had added advantages over the original instrument.

The title of the book is rather misleading. In its diagnostic and therapeutic sections, it deals in great detail with hearing defects and gives very little material on speech defects. The problems of the aphasic are covered only in the chapter on literature. Here, however, the author shows himself well informed—surprisingly well for a non medical writer—on the basic elements of the subject. The book is of definite value for the otologist and for the special worker in the field of speech disturbances.

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THE book on *Diathermy*,³ by Dr McKenzie is a summation of his personal experiences as applied to diseases of the ear, nose, and throat supplemented with all the literature available and the experience of other men. The book discusses diathermy fully but fortunately not too technically so that one may easily grasp the fundamentals.

Dividing the book into chapters dealing with (1) medical diathermy and its application to such cases as noma, middle ear diseases, etc., (2) surgical diathermy such as the removal of malignant growths, etc., (3) surgical diathermy in cancer, both eradicable and non eradicable, the author gives the technique and statistics on results obtained in a variety of cases. Some of his results have been very satisfactory, others not. The book is well written and is a lucid explanation of the best methods of application of diathermy to disease of the ear, nose, and throat. It will be a most valuable one to the busy practitioner seeking a ready reference to the latest uses of diathermy.

JOHN F DELPH

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² APHASIA IN CHILDREN. By Alex W G EWING, M.A. Ph.D. With an Introduction by L D ADRIAN, M.D. F.R.C.P. F.R.C.S. London: Oxford University Press, 1930.

³ DIATHERMY: MEDICAL AND SURGICAL. IN OTOLARYNGOLOGY. By DAA MCKENZIE, M.D. F.R.C.S. New York: The Macmillan Company, 1930.

and the menopause and its identity from malignancy and gave it the name of 'hyperplasia of the endometrium'.

Although a number of late workers considered the relationship between ovarian pathology and endometrial lesion leading to abnormal uterine hemorrhage, Kaji Lauth, Poelzl Adler (1) it remained for R. Schroeder (73, 74) in 1912 and again in 1919 to present a complete analysis of the whole problem with an extensive series of cases and to formulate his theory of the 'persistent ripening follicle'. This was followed in 1920 by a noteworthy contribution by R. Meyer (57) who, however, gave an interpretation of the ovarian changes different from that of Schroeder. Among the valuable studies on the anatomical changes of the endometrium in hyperplasia published between 1900 and 1920 were those of Huebner, Kjaergaard, Driesch and Novak (6) while since that time the problem in regard to both endometrium and ovary has been extensively discussed by Novak (6), Seft-Habes (7), Runge, Novak in (M. L. Adler (8), Beckman and Shryver. As a result a new era has been inaugurated in the development of hormonal therapy and to hyperplasia of the endometrium. The names of Siehke, Frank and Zander have been regarded as pioneer authors.

It is interesting to note that all embracing terms which have been used in the clinicopathologic literature are: (1) The use of the term 'endometrial hyperplasia' with objectives such as hyperplasia, hyperplasia and "fungosa" (2) or (3) hyperplasia and "fungosa" (4) suggested because of the method of classification. (5) Glandular hyperplasia and (6) glandular cystic hyperplasia describe only a phase of the endometrial picture while hyperplasia endometrial is descriptive of only the uterine manifestation of the disease. The use of Schroeder's metropathia hemorrhagica is of value but is liable to be confused with other conditions also resulting in uterine bleeding and hence must be mentioned with hesitancy. Since the etiology of the disease is as yet obscure it is probably better to refer to it by one of the terms describing the pathology of the endo-

metrium and defer the adoption of any descriptive name until later.

CLINICAL CHARACTERISTICS

This study is based on a series of 13 cases of hyperplasia endometrial from the gynecologic service of the Stanford University School of Medicine and from private practice. The cases were taken consecutively and in every instance the diagnosis was established by a histological examination of the endometrium.

Incidence. Schroeder (76) has estimated that glandular hyperplasia occurred in approximately 0.8 to 1.0 per cent of all the patients attending the clinics of Professor Kiel. The figures from the Stanford Gynecological Service also point to the frequency and importance of this disease. In 1926 1,700 hospital admissions it was estimated that in 40 cases an incidence of 2.3 per cent of 507 women with abnormal uterine hemorrhage 6 or 12 per cent were found to have a hyperplasia endometrial (Huebner and Meyer).

Age of occurrence. Many authors have devoted considerable attention to the incidence of hyperplasia and the results of the series are listed in Table I. It is well known that hyperplasia is a disease most frequently found at the time of the menopause and that 50 per cent of all cases occurred in women over the age of 35. This was also shown in a previous study (Huhmann 31) where it was found that of 38 women over 40 years of age with so-called idiopathic uterine hemorrhage the presence of hyperplasia was demonstrated in the endometrium in 31 cases. It must be observed, however, that the condition may occur at any time after the menarche and in the postclimacteric period.

TABLE I.—AGE INCIDENCE IN GYNECOLOGICAL HYPERPLASIA ENDOMETRII

| Age | No. of cases | Total |
|-------|--------------|-------|
| 15-19 | 2 | 13 |
| 20-24 | 1 | |
| 25-29 | 5 | |
| 30-34 | 13 | 14 |
| 35-39 | 15 | 23 |
| 40-44 | 13 | 14 |
| 45-49 | 18 | 17 |
| 50-54 | 6 | 13 |
| Total | | |

at least he named in addition to the repeatedly recommended ether and chloroform. The book has too many splendid points in its presentation to nurses of well tested methods, to be considered anything but a first rate work in its class.

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³ DIATHERMY MEDICAL AND SURGICAL, IN OTOLARYNGOLOGY. By Dr McKenzie M.D. F.R.C.S.E. New York: The Macmillan Company 1930.

ALTHOUGH the reviewer finds no change in the contents of the second edition from the first edition of *The Action of Muscles*¹ except the addition of a chapter on the erect posture, he welcomes the opportunity to praise Dr Mackenzie's book unreservedly. This is by all odds the most important volume dealing with muscle action and re-education. The author has not only engaged in the practice of physical therapy and superintended the rehabilitation of large numbers of disabled British soldiers, but he is also a comparative anatomist and director of the Australian Institute of Anatomy and he carries the viewpoint of the evolution of function and

structure into every chapter of his book. After an initial chapter on principles of muscle action and the testing of muscle action the following fourteen chapters deal with descriptions of the action of the various muscle and nerve muscle groups, with one chapter on the anatomical considerations in joint fixation. This small volume makes an ideal desk reference book. On every problem of disturbed muscle function and re-education, the author has some illuminating or stimulating comment to make.

JOHN S. COULTER

¹THE ACTION OF MUSCLES INCLUDING MUSCLE REST AND MUSCLE RE-EDUCATION. By Dr Colin Mackenzie M.D. F.R.C.S. F.R.C. (Edin.) New York Paul B Hoeber Inc 1930

BOOKS RECEIVED

Books received are acknowledged in this department and such acknowledgment must be regarded as a sufficient return for the courtesy of the sender. Selections will be made for review in the interests of our readers and as space permits.

LES DIAGNOSTICS ANATOMO CLINIQUES DE P. LECÈNE. RECUEILLES PAR SES ÉLÈVES II GÉNÉRALITÉS. By P. Pavie. Lésions du Sein. By P. Moulouquet. Paris: Masson et Cie 1930.

CHIRURGIEN DER ALLGEMEINEN INNEREN BEFRIEDIGENDEN PHARMAKOLOGISCHER BEFUNDE. By Dr Med Fritz Johannesson. Amsterdam: W. Bureau Tot Hetero dering Van Het Kinne. Gebruik 1930.

PHYSICIANS' MANUAL OF BIRTH CONTROL. By Antoinette F. Konikow M.D. New York: Buchholz Publishing Company 1931.

SURGICAL NURSING. By Hugh Cabot M.D. CMG F.A.C.S. and Mary David Giles B.S. R.N. Philadelphia and London: W. B. Saunders Company 1931.

VEIT'S HANDBUCH DER GYNEKOLOGIE. 3d rev. enlarged ed. Edited by W. Stoedel and collaborators. First half vol. 1 on Die Erkrankungen der Scheide. By Dr Ludwig Nuernberger. Munich: J. I. Bergmann 1930.

LOVETT'S LATERAL CURVATURE OF THE SPINE AND ROLAND HOLLIDAY. 3th ed. rev. and edited by Frank K. Ober M.D. and V. H. Brewster M.D. Philadelphia: P. Blakiston's Son & Co. Inc 1931.

CANCER DU PANCRÉAS. By Ch. Oberling and M. Cuérin. Paris: Gaston Douin & Cie 1931.

AN INTRODUCTION TO PHARMACOLOGY AND THERAPEUTICS. By J. A. Gunn M.D., D.Sc. (Edin.) M.A. (Oxon.) 2d ed. New York and London: Oxford University Press 1931.

THE TREATMENT OF CHRONIC DEAFNESS BY THE ELECTROPHONIC METHOD OF ZUEND-BURGHEIT. By George C. Cathcart M.A., M.D. 2d ed. New York and London: Oxford University Press 1931.

FRACURES AND THEIR COMPLICATIONS. By George Ewart Wilson M.B. (Tor.) F.R.C.S. (Eng.) F.A.C.S. New York: The Macmillan Company, 1931.

AN INTRODUCTION TO GYNECOLOGY. By C. Jeff Miller, M.D. St. Louis: The C. V. Mosby Company, 1931.

SELECTIONS FROM THE PAPERS AND SPEECHES OF JOHN CHALMERS DYCOSTA M.D. LL.D. Philadelphia and London: W. B. Saunders Company 1931.

DIE TECHNIK DES UNGEFÖLTERTEINER GEFÄSSVERBANDES. By Dr Fritz Schneek. Geleitet von Dozent Dr Lorenz Boehler. Vienna: Wilhelm Maudrich 1931.

THE THEORY OF OBSTETRICS, A FUNCTIONAL STUDY OF CHILD BEARING BASED ON A NEW DEFINITION OF NORMAL LABOUR AND ON A NEW THEORY OF UTERINE INERTIA AND ILLUSTRATED BY A DETAILED STATISTICAL ANALYSIS OF 100 CONSECUTIVE LABOURS, AND SOME RECORDS OF CASES OF PAINLESS LABOUR. By M. C. DeGans M.D. New York: William Wood and Company 1931.

ROENTGEN INTERPRETATION, A MANUAL FOR STUDENTS AND PRACTITIONERS. By George W. Holmes M.D., and Howard I. Ruggles M.D. 4th ed. rev. Philadelphia: Lea & Febiger 1931.

A TEXTBOOK OF SURGERY. By John Homans, M.D. Springfield, Illinois and Baltimore, Maryland: Charles C. Thomas 1931.

THE INHERENT FACTORS IN DISEASE. AN ESSAY. By Archibald E. Carroll M.C.M.G. D.M. LL.D. F.R.C.P., F.R.S. London and New York: Oxford University Press 1931.

COLLECTION DES ACTUALITÉS DE MÉDECINE PRATIQUE. Chirurgie Lithétique Pure (Technique et Résultats). By Raymond Lassot. Paris: C. Douin & Cie, 1931.

TRANSACTIONS OF THE AMERICAN GYNECOLOGICAL SOCIETY. Volume 55. For the Year 1930. Edited by Lloyd I. Keene M.D. St. Louis: C. V. Mosby Company, 1931.

LES DIAGNOSTICS ANATOMO CLINIQUES DE P. LECÈNE. RECUEILLES PAR SES ÉLÈVES II APPAREIL GÉNITAL DE LA FEMME. INFIMIERE PARTIE. By P. Moulouquet and S. Dobkevitch. Paris: Masson et Cie 1931.

THE LETTERS OF DR BETTFRMAN. By Charles Elton Blanchard M.D. Youngstown, Ohio: Medical Success Press, 1931.

SOME PRINCIPLES OF CANCER STATISTICS. RESEARCH BY Frederick I. Hoffman, LL.D. Prudential Press 1931.

SAN FRANCISCO CANCER SURVEY. SIXTH PRELIMINARY REPORT (Thirteenth, Fourteenth, Fifteenth and Sixteenth Quarterly Reports). By Frederick I. Hoffman LL.D. Newark, N. J.: The Prudential Insurance Co. of America, 1931.

A HANDBOOK FOR SENIOR NURSES AND MIDWIVES. By J. K. Watson M.D. (Edin.) 2d ed. New York and London: Oxford University Press 1931.

THE DIET BOOK, FOR DOCTOR, PATIENT AND HOUSEWIFE. With Specimen Menus for One Week and Recipes by Marguerite Requa Kea (Mrs. Nec L. Rea). With a foreword by Sir James I. Stewart M.C. C.B. M.D. (Ed.), J.R.C.E. (Lond.) London: Oxford University Press 1931.

CLINICAL CONGRESS OF AMERICAN COLLEGE OF SURGEONS

C JEFF MILLER, NEW ORLEANS, *President*

ALLEN B KANAVAL, CHICAGO, *President-Elect*

FRANKLIN H MARTIN, CHICAGO, *Director-General*

CHARLES GOROON HEYO, *Chairman, New York Committee*

JOHN E JENNINGS, *Chairman, Brooklyn Committee*

THE 1931 CLINICAL CONGRESS IN NEW YORK AND BROOKLYN

UNDER the leadership of strong and representative committees, the surgeons of New York and Brooklyn are developing an attractive program of clinics and demonstrations for the entertainment of Fellows of the College and their guests at the twenty-first annual Clinical Congress of the American College of Surgeons, October 12-16, 1931. All departments of surgery will be represented therein—general surgery, gynecology, obstetrics, orthopedics, urology, surgery of the eye, ear, nose, throat, and mouth.

Operative clinics and demonstrations in the hospitals are scheduled for Monday afternoon at 2 o'clock and for the mornings and afternoons of each of the four following days. A preliminary clinical program will be published in the next issue of **SURGERY, GYNECOLOGY AND OBSTETRICS**.

In the clinical program special emphasis will be laid on modern methods in the treatment of fractures, treatment of cancer by surgery, radium, and the X-ray, electrosurgery, rehabilitation of patients injured in industrial accidents, etc.

Programs for a series of evening meetings are being prepared by the Executive Committee of the Congress. At the presidential meeting on Monday evening, the president-elect, Dr Allen B Kanavel, of Chicago, will be inaugurated and deliver the annual address. Another feature of that session will be the John B Murphy oration in surgery to be delivered by Arthur H Burgess, M B, F R C S, Manchester, England, professor of clinical surgery in Victoria University, Manchester, and president of the British Medical Association. At the scientific meetings on Tuesday, Wednesday, and Thursday evenings, eminent surgeons of the United States and Canada with

distinguished visitors from abroad have been invited to present papers dealing with surgical subjects of present-day importance. The annual convocation of the College will be held on Friday evening at which the 1931 class of candidates for fellowship in the College will be received.

Subcommittees in charge of the section on surgery of the eye, ear, nose, and throat have arranged for two evening sessions at the Academy of Medicine at which papers and demonstrations of special interest to practitioners in those special branches of surgery will be presented.

General headquarters for the Clinical Congress will be established at the new Waldorf-Astoria Hotel, located on Park Avenue between 49th and 50th streets. This magnificent new hotel, with more than two thousand guest rooms, which will be opened on October 1st, offers unusual facilities for sessions of the Clinical Congress. Surgeons who have attended the three previous sessions of the Clinical Congress in New York when headquarters were at the old Waldorf-Astoria will find in the new hotel all the comforts and facilities of the old hotel with many added attractions and conveniences. The grand ballroom and other large rooms and foyers on the second floor of the hotel have been reserved for the exclusive use of the Congress for scientific meetings, conferences, film exhibitions, registration and ticket bureaus, bulletin boards, executive offices, scientific and technical exhibitions, etc.

The Congress opens at 10 o'clock on Monday morning with the annual hospital conference in the grand ballroom of the Waldorf-Astoria. The hospital conference will continue on Tuesday and Wednesday with an interesting program of pa-

pers, round table conferences, and practical demonstrations dealing with problems related to hospital efficiency, planned to interest surgeons, hospital trustees, executives and personnel generally. An invitation is extended to all persons interested in the hospital field to attend this conference.

Other important features of the Congress include a symposium on cancer and conference on cancer clinics, hospitals, and institutes, daily exhibition of surgical films, an all day conference on traumatic surgery in which leaders in industry, education, and labor, together with representatives of insurance companies, surgeons, and hospital administrators, will participate.

An application for reduced railway fares on account of the meeting in New York and Brooklyn is pending before the railroad traffic associations, and it seems assured that a rate of one and one-half the regular first class one way fare will be in effect from all points in the United States and Canada.

Attendance at the New York Brooklyn session will be limited to a number that can be comfortably accommodated at the clinics, the limit of attendance being based upon the result of a survey of the amphitheatres, operating rooms, and laboratories in the hospitals and medical schools to determine their capacity for accommodating visitors. Under this plan it will be necessary for those who wish to attend to register in advance.

Attendance at all clinics and demonstrations will be controlled by means of special clinic tickets, which plan provides an efficient means for the distribution of the visiting surgeons among the several clinics and insures against overcrowding, as the number of tickets issued for any clinic will be limited to the capacity of the room in which that clinic will be given.

A registration fee of \$5.00 is required of each surgeon attending the annual Clinical Congress, such fees providing the funds with which to meet the expenses of the meeting. To each surgeon registering in advance a formal receipt for the registration fee is issued, which receipt is to be exchanged for a general admission card upon his registration at headquarters. This card, which is non transferable, must be presented in order to secure clinic tickets and admission to the evening meetings.

COMMITTEE ON ARRANGEMENTS

New York

Charles Gordon Heyd Chairman

Ralph R. Moolten Secretary

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| R. T. Atkins | S. J. Kopetzky |
| Frederick Bancroft | A. Kanda |
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SURGERY, GYNECOLOGY AND OBSTETRICS

AN INTERNATIONAL MAGAZINE, PUBLISHED MONTHLY

VOLUME LII

JUNE, 1931

NUMBER 6

HYPERPLASIA OF THE ENDOMETRIUM AND THE HORMONES OF THE ANTERIOR HYPOPHYSIS AND THE OVARIES¹

C F FLUHMAN, M.D. C.M., SAN FRANCISCO, CALIFORNIA

From the Department of Obstetrics and Gynecology, Stanford University School of Medicine

HYPERPLASIA of the endometrium is not only one of the most important factors in any consideration of abnormal uterine bleeding but presents an interesting endocrine problem, the solution of which should do much to further our understanding of the phenomena of menstruation. It should therefore, not be considered as merely a local reaction in the uterine mucosa but as a clinicopathological entity, and from this aspect the recent advances in our knowledge of the sex hormones of the anterior hypophysis and the ovaries have served to clarify certain obscure features of the condition. The present study was undertaken in order to consider the relationship between the various hormones and hyperplasia endometrial, and to analyze the clinical and pathological findings in a series of 75 cases.

HISTORY

According to Olshausen and Bischoff, it would seem that the earliest clinical observations of this condition were made by members of the French school, as for instance Robert in 1846, Robin in 1848, and Nelaton in 1853. It was described as an overgrowth of endometrium forming sessile or polypoid masses, frequently containing dilated "utricular" glands, and was given the name of *etat fongueux*. In 1850, Recamier advised the use of the curette

as a method of treatment, but met with opposition when Aran (1858) and Becquerel (1859) decried such a "hazardous" and "barbarous" procedure. However, it is very likely that these pioneers included in this category other polypoid conditions of the endometrium as well as hyperplasia, and the first histological description was given in a notable paper by Olshausen in 1875, in which it is evident that he recognized its association with uterine bleeding and gave it the name of "endometritis fungosa" or "chronic hyperplastic endometritis." This was succeeded by the studies of Bischoff in 1878 and Ruge in 1880, and in 1882 Brennecke made his invaluable contribution. This author recognized certain characteristic changes in the ovaries of patients with endometritis fungosa, namely, a thickening of the tunica albuginea, the presence of unruptured follicles, and an absence of corpora lutea, and postulated the theory that these changes are directly responsible for the endometrial lesion (endometritis ovarialis). During the following 18 years, a number of investigators discussed this problem (Czempin, Gottschalk, Winternitz, Bulius and Kretschmar, Franz), and in 1900 Cullen (19) gave the first description in this country. In this book and in subsequent writings (20, 21) he established the close relationship between this lesion and uterine bleeding at the time of puberty

¹ Given at a meeting of the San Francisco and Bay Counties Obstetrical and Gynecological Society, October 10, 1930.

and the menopause and its identity from malignancy and gave it the name of "hyperplasia of the endometrium"

Although a number of later workers considered the relationship between ovarian pathology and endometrial lesions leading to abnormal uterine hemorrhage (Kaji, Lauth, Poelzl, Adler, 1), it remained for R. Schroeder (73, 74) in 1915 and again in 1919 to present a complete analysis of the whole problem with an extensive series of cases, and to formulate his theory of the "persistent ripening follicle." This was followed in 1920 by a noteworthy contribution by R. Meyer (57) who, however, gave an interpretation of the ovarian changes different from that of Schroeder. Among the valuable studies on the anatomical changes of the endometrium in hyperplasia published between 1900 and 1920 were those of Buettner, Kjaergaard, Driessen, and Novak (62), while since that time the problem in regard to both endometrium and ovary has been extensively discussed by Novak (63), Seitz, Babes (7), Runge, Novak and Murtzloff, Adler (2), Beckman, and Shaw. And finally, a new era has been ushered in with the development of hormonal studies and in regard to hyperplasia of the endometrium the names of Siebke, Frank, and Zondek must be regarded as pioneers in the field.

TERMINOLOGY

There is as yet no satisfactory all embracing name which would establish the clinicopathological entity of this condition. The use of the term "endometritis" with adjectives such as "hyperplastic," "polypoid," "fungosa," "ovariasis," should be discouraged because of the implied relation to infection. "Glandular hyperplasia" and "glandular cystic hyperplasia" describe only one phase of the endometrial picture, while "hyperplasia endometrii" is descriptive of only the uterine manifestation of the disease. The use of Schroeder's "metropathia hemorrhagica" is of value but is liable to be confused with other conditions also resulting in uterine bleeding and hence must be mentioned with his name. Since the etiology of the disease is as yet obscure, it is probably better to refer to it by one of the terms describing the pathology of the endo-

metrium, and defer the adoption of an inclusive name until later.

CLINICAL CHARACTERISTICS

This study is based on a series of 75 cases of hyperplasia endometrii from the gynecological service of the Stanford University School of Medicine and from private practice. They were taken consecutively and in every instance the diagnosis was established by a histological examination of the endometrium.

Incidence. Schroeder (76) has estimated that glandular hyperplasia occurred in approximately 0.8 to 1.0 per cent of all the patients attending the clinics of Rostock and Kiel. The figures from the Stanford Gynecological Service also point to the frequency and importance of this disease. In the last 1,700 hospital admissions it was demonstrated in 40 cases, an incidence of 2.8 per cent, while of 507 women with abnormal uterine hemorrhage 62, or 12.2 per cent, were found to have a hyperplasia endometrii (Fluhmann and Morse).

Age of occurrence. Many authors have devoted considerable attention to the age incidence of hyperplasia, and the findings of this series are listed in Table I. It is seen that hyperplasia is a disease most frequently found at the time of the menopause since more than 50 per cent of all cases occurred in women over the age of 35. This was also shown in a previous study (Fluhmann, 31), where it was found that of 33 women over 40 years of age with so called "idiopathic uterine hemorrhage" the presence of hyperplasia was demonstrated in the endometrium in 23 instances. It must be observed, however, that the condition may occur at any time after the menarche, and in the postmenstrual period it may

TABLE I — AGE INCIDENCE IN GLANDULAR HYPERPLASIA ENDOMETRII

| Age | No. of cases | Per cent |
|-------|--------------|----------|
| 15-19 | 2 | 2.6 |
| 20-24 | 2 | 2.6 |
| 25-29 | 5 | 6.7 |
| 30-34 | 13 | 17.4 |
| 35-39 | 10 | 13.3 |
| 40-44 | 13 | 17.4 |
| 45-49 | 18 | 24.0 |
| 50-55 | 6 | 8.0 |
| Total | 75 | |

accompany certain ovarian new-growths. Although it has been cited as an important factor in "puberty bleeding" (Wolfe), in this series there were only two patients of less than 20 years of age.

Gravidity Of the 75 patients of this series, 53 had had full-term pregnancies preceding the onset of the present condition, 14 were nulligravidae, while 8 had had from 1 to 5 abortions and had not carried a baby to term. It was also noted that 29 of the multigravidae had had previous abortions. It is questionable if this feature was a direct result of the hyperplasia. A more likely explanation is that these patients had hemorrhages following a period of amenorrhoea, which is a characteristic feature of hyperplasia, and thus led to a faulty diagnosis. In 2 cases the patients had full term pregnancies subsequent to a curettage which demonstrated a hyperplasia endometrii.

Symptoms The outstanding symptom of hyperplasia endometrii is that of abnormal uterine bleeding, a fact which led Schroeder to apply the term "metropathia haemorrhagica" to this condition. It was found that the patients of this series could be classed into two main categories according to certain characteristics of the bleeding, and in accordance with previous studies (Fluhmann 28, 31, Fluhmann and Morse) each of these was again divided into a number of subgroups.

In the first large group were 25 patients in whom there was a definite cycle in the appearance of periods of bleeding and intervals of rest. These again were subdivided into:

1 A group of 12 patients (16.0 per cent) who complained of *menorrhagia*, that is, who had a 28 or 30 day cycle but the period of bleeding had become very profuse or prolonged as compared to the preceding menses.

2 Thirteen patients (17.4 per cent) stated that they had "irregular menses" in that (a) periods of blood loss occurred at less than 4 week intervals (8 cases), or (b) at intervals of longer than 4 weeks (3 cases), or (c) were very irregular, the interval sometimes being shorter and sometimes longer than 4 weeks (2 cases).

In the remaining two-thirds of the cases, the bleeding was prolonged, continuous, or intermittent, in duration. These again were divided into smaller groups:

1 A period of continuous bleeding which persisted until the patient was admitted for treatment and which set in following previously normal menses, was found in 12 instances (16.0 per cent). In 10 cases the onset of the hemorrhage coincided with the time a menstrual period was due and in 2 cases it occurred a short time after the completion of a normal period.

2 A small group of 5 cases (6.7 per cent) was characterized by a progressive condition initiated by profuse or irregular periods of blood loss which became gradually worse until eventually they ended in atypical or irregular bleeding.

3 In 14 cases (18.6 per cent) continuous bleeding set in following a period of amenorrhoea. This feature is of considerable importance from a diagnostic standpoint and may be considered as a very characteristic symptom of hyperplasia endometrii. The period of amenorrhoea is usually of from 6 to 8 weeks in duration, but in this series it lasted for 2 months or longer in 6 cases, and in 2 instances was as long as 7 months and 2 years respectively.

4 In 18 patients (24.0 per cent) the type of bleeding was absolutely atypical and irregular as to time, intensity, and duration.

5 One patient with hyperplasia endometrii accompanying an ovarian new-growth had irregular bleeding although she had passed the menopause 2 years previously.

Duration of symptoms The length of time symptoms were present before the patients came for treatment has proved to be a very variable factor and depended a great deal on the type and severity of the bleeding, for instance the patients with "menorrhagia" usually reporting later. The duration varied between 2 weeks and 7 years. Sixteen patients had had bleeding for less than 3 months, 14 for from 3 to 6 months, 13 for from 6 months to 1 year, 12 for from 1 to 2 years, and 13 for more than 2 years, while in 7 instances this information had not been obtained.

Associated conditions (a) Systemic disease. Although a few of the patients suffered from complications such as cardiovascular disease, nephritis, etc., no connection between these and hyperplasia endometrii could be estab-



Fig. 1

Fig. 1 Photomicrograph illustrating various types of regular glands in hyperplasia endometrii (Spec No 10751) x 75



Fig. 2

Fig. 2 Cystic glands and a dense stroma are characteristic features of hyperplasia endometrii (Spec No 93586) x 6



Fig. 3

Fig. 3 Stratification of the glandular cylindrical epithelium (Spec No 14137) x 335

lished. The information available also failed to point to any definite relationship with known endocrine disturbances and led one to believe that no such connection existed. Only 4 patients had had a basal metabolic rate done and since the results showed 1 as plus 17, another as minus 19, and the other 2 as plus 4 and plus 3 respectively, it was impossible to demonstrate any characteristic involvement of the thyroid gland. In a number of instances a marked secondary anemia was present, a direct result of the severe hemorrhages associated with hyperplasia endometrii.

(b) Pelvic disease. On the other hand, pelvic conditions associated with hyperplasia endometrii were found in approximately 30 per cent of the cases. In 8 instances fibromyomata were present in 2 fibromyomata and endometrial polypi in 1, an adenomyoma in 1, a polyp of the cervix uteri in 3, endometrial polypi in 8, a retroversio uteri and in 1 an early prolapsus uteri. In view of the relationship between the ovary and the endometrium in this disease, it was interesting to find a granulosa cell carcinoma in one case, a small fibroma in 3 cases, and a very small serous cystadenoma in one instance.

Pelvic examination. Although in most cases no gross pathology can be made out on pelvic

examination and as a result patients with hyperplasia endometrii not complicated by other pelvic disease belong to the indefinite category of "idiopathic uterine hemorrhage," there are generally a few very suggestive findings for the careful observer. These are most readily demonstrated if the patient is actually bleeding at the time the examination is made and simulate the picture of an early abortion. There is a congestion of the pelvic organs, turgor and slight enlargement of the uterus and a softening at the level of the internal os similar to the well known Hegar's sign. In a considerable number of instances it is also possible to palpate the ovaries and to find that one or both are somewhat enlarged and cystic.

PATHOLOGY OF THE ENDOMETRIUM

The pathological material available for this study was composed of a single specimen of curettings in 50 cases, of 2 specimens of curettings obtained at different times in 1 case, of both curettings and the uterus (removed at a later period) in 8 cases, and of the uterus alone in 16 instances. The tissues were fixed in formalin mounted in paraffin and the sections were stained routinely with eosin and hematoxylin. In certain cases special stains, such as van Gieson's for collagen fibrils, mucicar

min for secretory changes in the glands, and methyl-green pyronin for plasma cells, were employed

The gross appearance of the endometrium shows that in many instances it is markedly thickened and oedematous and large amounts of material may be obtained as the result of a curettage. In some cases the surface is rugged and shows irregular prominences, a feature which led to the use of the terms "polypoid" and "fungous." Although the occurrence of definite polypi is supposedly a frequent accompaniment it was noted in only 5 of the 75 cases of this series.

The diagnosis is established, however, by a microscopic examination of the endometrium, and in order to recognize the significance of certain histological changes, it is necessary to remember that differences occur depending on whether the specimen is obtained at a time when the patient is bleeding or not. This is a fundamental principle regarding any studies on the endometrium, for we are dealing with a structure which is never in a state of "rest" but undergoes daily variations during the active sexual life of the individual, and although hyperplasia is considered as a pathological condition there is nevertheless a process of growth, destruction, and repair bearing a similarity to the events of the normal menstrual cycle.

A Hyperplasia endometrii in non-bleeding cases. The endometrium presents an appearance which at once suggests an intense growth activity. It has essentially the same features throughout its whole depth, and it may be difficult even to differentiate the basal from the functional layer. The normal cyclical changes are not present. The stroma is dense and cellular, the cells are spindle-shaped, and evidence of active proliferation is seen in numerous mitotic figures. Special staining methods reveal the presence of collagen fibrils (Schroeder, 76, Babes, 7), and oedema is frequently present. In many cases there are also important vascular changes. During the stage of proliferation in the normal endometrium, one usually sees larger branches of blood vessels near the basalis, whereas only an occasional one is visible in the superficial layers. In hyperplasia the presence of numerous large



Fig 4 Areas of tissue disintegration, the local factor responsible for uterine hemorrhage (Spec No 12801) $\times 75$

vessels extending throughout the whole depth of the tissue is a prominent feature, and in some instances there are markedly dilated veins under the surface epithelium.

It is in the glands, however, that one must look for the most striking changes. The first notable feature is a totally disorderly arrangement of the glands as compared to the usual normal vertical extension from the basalis to the surface, second, there is a notable increase in the number present, and finally there is a tremendous variation in their size and shape as seen in cross section. There are also certain characteristic changes in the cells of the glands and on this basis three different varieties may be recognized: (1) *Glands with a single layer of cylindrical epithelium*, which are identical to those normally found during the stage of proliferation. At times they are branched and show various irregularities in their contour (Fig 1). It is very important to note that glands in a state of secretion are usually absent. They may occasionally be found, but in the specimens of this series they were never as fully developed as those of the normal pregravid phase and unaccompanied with corresponding changes in the stroma. However, Schroeder (76) and Runge (71)



Fig 5

Fig 5 Areas of necrotic tissue (Spec No 7926) $\times 75$
 Fig 6 Thrombosis of large blood vessel (Spec No 13336) $\times 75$



Fig 6



Fig 7

Fig 7 Section showing groups of large vacuolated cells which were found in the lumen of a gland (Spec No A3519-2) $\times 450$

maintain that in some instances secretory changes are superimposed on the endometrium and accompany corpus luteum formation with spontaneous healing of the endometrial lesion (2) *Cystic glands* with a low cuboidal epithelium were noted in 62 specimens and are an important characteristic of hyperplasia endometrii (Fig 2). However, since they are found normally in the basal layer of the endometrium at any stage of the menstrual cycle as well as in certain cases of endometritis and atrophy endometrii, it would be wrong to base the diagnosis of hyperplasia on their presence alone. (3) *Glands with stratified epithelium* again reflect the marked growth activity which is so characteristic of this disease. They are usually of moderate size but some times are very large and on cross section are round, star shaped, or branched, and may have papillary projections into their lumina. The cells are of the cylindrical variety but form from 2 to 5 layers (Fig 3). Mitotic figures are to be found, and these structures have at times been confused with carcinomatous changes and have been labeled as either cancer or "precancerous."

B *Hyperplasia in bleeding cases* The importance of recognizing the distinction between specimens of hyperplasia endometrii obtained at a time when the patient is bleeding and when she is not cannot be overemphasized, for if the curettings are taken at the

time the patient is bleeding two important additional factors are found in the endometrium, namely, the presence of areas of necrosis and thrombosis of blood vessels, and second, an extensive infiltration with leukocytes.

The presence of areas of necrosis has been described in particular by Schroeder who considers them as the result of a thrombosis of blood vessels and as the immediate factor concerned with bleeding. A number of subsequent writers have focused their attention on the occurrence of thromboses and have failed to find them as frequently as Schroeder, although they noted them in isolated instances (Seitz, Adler, 2, Novak and Martzloff, Beckman, 9). However, in more recent studies, Shaw has given special attention to localized areas of disintegration and considers this finding as one of the most characteristic features of hyperplasia endometrii, while von Mikulicz Radecki, in his examinations of the uterine cavity with a hysteroscope, found that bleeding in these cases came from defects in the surface of the mucosa.

Forty seven of the specimens of this series were obtained either while the patient was actually bleeding or the hemorrhage had ceased a short time before the operation, in 24 cases hemorrhage had not occurred for some time, and in 4 this information could not be determined with certainty from the clinical

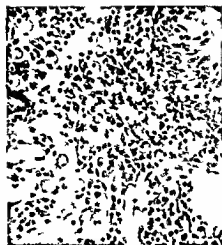


Fig 8

Fig 8 The occurrence of large cells with eccentric nuclei and resembling tissue histiocytes, have been noted in the endometrial stroma in a few instances (Spec No 5128) $\times 335$



Fig 9

Fig 9 Epidermidization of the surface mucosa in hyperplasia endometrii (Spec No 7194) $\times 335$



Fig 10

Fig 10 Theca lutein cyst of the ovary (Spec No A2968) $\times 335$

history It was now found that definite areas of necrosis (Figs 4 and 5) could be demonstrated in 20 of the 47 patients who were bleeding at the time of the curettage or hysterectomy, and only twice in the 24 who were not bleeding when the specimen was obtained. In addition, thromboses of large blood vessels were seen in most of the necrotic regions examined, and several times in healthy tissues (Fig 6). It is felt that this finding strongly supports Schroeder's contention that tissue disintegration occurs and is the immediate factor responsible for the hemorrhage. The finding of 2 cases with necroses in non-bleeding patients may very well be explained on the assumption that hemorrhage was imminent and this is borne out by one of these patients who had had cyclical bleeding and the next "period" was due. Although necroses were found in only 43 per cent of the bleeding cases, it is most important to remember that the negative finding is not conclusive in view of the technical difficulties associated with their demonstration. These were outlined in a previous study (Fluhmann, 31) and since that time the importance of this feature has been appreciated more and more in the Stanford Gynecological laboratory.

The second important finding associated with hemorrhage in cases of glandular hyperplasia is an extensive infiltration of the tissues

with leucocytes. This feature is considered as unusual by a number of previous investigators (Babes, 7, Novak and Martzloff) but in these studies apparently no differentiation was made between specimens from "bleeding" and "non-bleeding" patients. An analysis of the cases of this series, however, shows that marked infiltration of the endometrium, and especially near the surface, with polymorphonuclear leucocytes and lymphocytes was noted in 39 of the 47 bleeding cases, including all those with areas of necrosis, while it was observed only 6 times in the 24 non bleeding patients. This observation is of interest in



Fig 11 Lutein cyst of the ovary found in one case of hyperplasia endometrii (Spec No A3319) $\times 335$



Fig 12



Fig 12



Fig 13

Fig 12 (Spec No 4638, 2 and 3) Photomicrographs of the same magnification illustrating the marked growth of the uterine mucosa following the administration of oestrin. The left photomicrograph is of the uterus of an adult mouse castrated 4 weeks previously, while the right one shows a section of the uterus of another mouse

spayed at the same time and given 30 rat units of oestrin (amniotin Squibb) over a period of 8 days $\times 70$

Figs 12, 13 Mitotic figures indicating growth activity of the uterine mucosa of a spayed rat following the administration of oestrin (amniotin Squibb) (Spec No 46758) $\times 715$

that it at once suggests the similar appearance of large numbers of leucocytes in the normal endometrium just before and during menstruation and in the endometrium when a premature 'menstruation' is induced by cauterization of the corpus luteum (White house). True inflammatory cells such as plasma cells are generally absent. Shaw has already drawn attention to large vacuolated cells which occur in groups in the lumina of the glands and considers them as degenerated epithelial cells. These were observed in a considerable number of specimens both from bleeding and non bleeding cases (Fig 7), but in addition certain large cells with eccentric nuclei were noted in the stroma in a few instances (Fig 8). It would seem that the latter at least are a type of tissue 'histiocyte' similar to those found in the uterus and broad ligament during pregnancy and the puerperium (Hornung, Hofbauer, 50, Iulmann, 27, Teacher).

Epidermalization in hyperplasia endometrii and relation to cancer. In 2 of the specimens of this series was noted a transformation of the surface epithelium to a type resembling squamous epithelium (Fig 9). This process is of special interest in that it may lead to confusion with carcinoma and is similar to the "epidermalization" seen in the cervix uteri in various conditions (Iulmann, 25). Of interest also is the rare occurrence in hyperplasia

of islands of cells in the deeper layers of the mucosa which closely resemble the basal layer cells of normal squamous epithelium. This condition was discussed in a previous communication (Iulmann, 26) when one case was reported in detail. At the time the writer had found only 5 other cases in the literature, 3 of which had been regarded as carcinoma but 2 reports had been overlooked, namely that of Aschheim with 3 cases and that of Ahlstrom with one case. Since then the total has been brought to 19 by Hintze, who has recently described 9 additional instances.

Although glandular hyperplasia endometrii has no direct connection with malignancy, the possibility of the co existence of the two conditions, especially in women of the menopausal age, must always be kept in mind. This has been found on one occasion in this laboratory and was described in detail in a previous article (Iulmann and Stephenson).

Uterine polypi. In only 1 instance of the 75 cases of this series was a cervical polypus noted and there is no reason to suspect the existence of any relation between the two conditions, since these small tumors are probably solely an accompaniment of chronic pelvic congestion (Iulmann, 24). On the other hand, 5 endometrial polypi were found which presented a histological picture of hyperplasia identical to the uterine mucosa of each individual case.

Differential diagnosis Although hyperplasia of the endometrium presents, as a rule, but little difficulty in histological diagnosis, it is especially to be differentiated from conditions which are associated with the formation of cystic glands, such as certain cases of senile endometrium. It is also of importance to distinguish it from "simple hypertrophy of the endometrium" which likewise presents a marked overgrowth of the endometrium and hyperæmia, but is recognized by the regular arrangement of the glands and the corresponding cyclical changes.

OVARIES

Of primary importance in the consideration of hyperplasia of the endometrium and especially in any discussion as to its etiology, are the co-existent changes which have been described in the ovaries of these patients. Since the first discussion of this aspect of the problem by Brennecke in 1882, R. Schroeder and R. Meyer have offered the most outstanding contributions to this question.

Schroeder's first papers on the subject appeared in 1915 (73) and 1919 (74), and in 1928 he published his final observations in Veit-Stoeckel's *Handbuch der Gynaekologie* (76). He has made complete examinations of both ovaries and the uterus in a total of 62 cases of glandular-cystic hyperplasia of the endometrium. In no case was he able to find a mature corpus luteum, and in 53 specimens the ovaries contained one or more small cysts, which on microscopic examination were seen to be lined by well-preserved granulosa and theca layers indistinguishable from a normal ripening follicle. In a few instances he was able to demonstrate the presence of the ovum in the granulosa layers of the cyst, and only occasionally was there any evidence of degeneration of the granulosa with beginning hypertrophy of the theca. In 9 cases were follicles undergoing degeneration, and in addition a very early corpus luteum was seen in 3 of these specimens. The histological picture of the endometrium in these 9 cases was essentially the same as in the first large group, although the process of disintegration was more marked and in some instances very early evidence of secretion could be seen in the glands.

On the basis of these observations Schroeder developed his theory regarding the nature of hyperplasia, that the endometrial change is directly due to a stimulation from a "pathological persistence of a ripening follicle," that is, ovulation does not occur and the ovum does not die but persists in the follicle which continues to function. After a time the ovum dies and if a similar persistent follicle does not arise, the endometrium atrophies or is cast off, and spontaneous healing takes place.

The findings which R. Meyer published in 1920 (57) substantiated the absence of corpus luteum formation which Schroeder had reported although he felt that this condition was only applicable to a certain number of cases of hyperplasia, and he also gave a different interpretation to the cystic structures present in the ovaries. Although he noted cysts with a normal granulosa he also found large cysts due to follicle atresia and with unusual hypertrophy of the theca cells (granulosa-epithelial lutein cysts). He, therefore, did not accept Schroeder's conception of a persistent functioning follicle. His interpretation is that the follicle does not reach complete development and that the ovum dies prematurely. This follicle then undergoes atresia, and another immediately begins to develop and undergoes the same process. His conception is thus similar to Brennecke's except that he does not consider the thickening of the albuginea as the cause for the absence of ovulation, but attributes it to an inherent weakness of the ovum in the process of development. Although there is some difference in the two theories as regards the significance of the ovarian changes, the basic effect remains the same since in both cases there is a prolonged stimulation to the endometrium.

The ovarian findings reported by Schroeder and Meyer have been corroborated by a number of subsequent investigators, except for a few isolated instances of the co-existence of hyperplasia endometrii and mature corpora lutea. Seitz described a few cases of hyperplasia in which the ovaries presented abnormal lutein structures, which he felt must be considered as incapable of functioning in the same manner as the normal yellow body. Babes (7), in Meyer's laboratory, analyzed 25

complete specimens and found corpora lutea in 3 instances, 2 of which he described as of about 3 weeks' development and the third as in the stage of vascularization. As Schroeder (76) observes, however, the description given for the endometrium in these cases makes one doubt if the author was actually dealing with the same condition described in his work and in this paper. Novak and Martzloff were able to obtain only incomplete ovarian material, but nevertheless found mature corpora lutea accompanying hyperplasia endometrii in 4 instances. Shaw, in a more recent study, examined both ovaries in 12 cases and found in most instances atrophied organs with unilateral cysts which generally proved to be cystic ripening follicles. In 2 cases he found that follicle rupture had recently occurred, and in one he noted a recent corpus luteum. Since the endometrium in the latter case "showed corresponding cyclic changes" it would seem that here again the author was dealing with a condition which is not identical to that considered in this study. Beckman also found 3 specimens with mature corpora lutea but these cases were unaccompanied by the profuse hemorrhages generally associated with hyperplasia.

Of special interest in this phase of the problem is the occurrence of hyperplasia endometrii in the postclimacteric period and in association with ovarian new growths, chiefly granulosa cell tumors but also fibromata and sarcomata. In 1922, Schroeder (75) described one such case and Moulouquet Doleris made similar observations in two instances in 1924. Since then a considerable number of cases have been reported, for instance by R. Meyer (58), Neumann, Isbruch, Babes (8), Tietze, Schroeder (76), Frankl Robinson.

Owing to the conservatism in dealing with the ovaries which is practiced on the Stanford Gynecologic service, only a few cases are available in which both ovaries were removed. Three of these are from patients of this series, a fourth (No. A2968) is from a previously reported case of hyperplasia associated with a very early carcinoma (Muhmann and Stephenson), while the fifth is a patient who had had a previous unilateral oophorectomy, so that the examination of the remaining ovary

at the time she had hyperplasia may be considered as representing the complete ovarian picture. The details of these findings are as follows:

Specimen 3256. Patient was 36 years of age. The left ovary contained two small cysts the larger measuring 1.5 centimeters. One of these was lined by well preserved granulosa cells and a markedly hypertrophied theca (theca lutein granulosa cyst); the second was a similar cyst there was only slight hypertrophy of the theca cells here and there. A small fibroma was present in one pole of the ovary. The right ovary did not show anything beyond a few primordial follicles.

Specimen A2968. Patient was 44 years of age. Both ovaries contained a number of small cysts. The left showed two atretic cysts with a fibrous tissue lining, one cyst with a well preserved granulosa cell lining and two early developing follicles. The right showed two atretic cysts lined with fibrous tissue and one large theca lutein cyst (Fig. 10).

Specimen A5075. Patient was 49 years of age. One ovary had been removed 19 years before and the present specimen showed numerous corpora albicantia, one granulosa cyst similar to those mentioned above and a small serous cystadenoma.

Specimen 8015. Patient was 36 years of age. The left ovary contained a theca lutein cyst and the right a fibroma.

Specimen A1581. Patient was 51 years of age 2 years past the menopause. The left ovary showed a granulosa cell carcinoma while the right was a small sclerotic senile structure.

It is thus seen that no evidence of a recent corpus luteum was noted in a single instance. In 3 cases follicle cysts with a well preserved granulosa cell layer were found, a fourth case showed a fibroma ovum on one side and a theca lutein cyst on the other, while the fifth was from a patient 2 years past the menopause and showed a granulosa cell carcinoma. In addition, a careful inspection of both ovaries in the course of a laparotomy in 2 recent cases failed to show any structures which could be recognized grossly as corpora lutea and in one of these cases numerous small cysts in each ovary were opened with the thermocautery. In another patient who had had one ovary removed one year before, the remaining ovary was found to be the size of a large walnut and to contain two small cysts. One of these was resected and histological examination showed the lining to be composed mainly of three to five rows of large theca lutein cells as in Figure 10, but in certain

areas the lutein cells were smaller and formed from 10 to 15 rows, and there was no fibrous tissue formation (Fig 11)

The remaining available material from the patients of this series cannot be considered as of importance and need only be mentioned briefly In 1 case both ovaries were obtained, but since the patient had been treated with radium a few weeks before the operation, no finding could be taken as necessarily characteristic of hyperplasia In 9 of the cases only one ovary had been removed and in a study such as this the value of incomplete material is very doubtful No corpora lutea were noted but three types of cysts were found—follicle cysts with well preserved granulosa cells, atretic follicles with a degenerating granulosa layer and fibrous tissue formation, and theca lutein cysts In one instance a small fibroma was present in one pole of the ovary

FUNCTIONAL STUDIES

An important development resulting from the epoch-making discoveries in the sphere of the sex hormones during the past few years has been the elaboration of biologic tests for certain endocrine substances which are vital factors in normal and abnormal ovarian and uterine function The two main tests are those for the sex factors of the anterior hypophysis (Aschheim-Zondek) and for the oöstrus-producing ovarian hormone (Allen-Doisy) The employment of these tests in studying patients with disturbances of menstruation is a great advance and their importance is as yet but little appreciated

Although the Aschheim-Zondek test has been almost completely limited to its use as a "pregnancy test" there is very good evidence that it may prove of considerable value in the study of other conditions For the past 2½ years a modification of this test which requires the examination of blood serum for the presence of unduly large amounts of anterior pituitary sex hormone has been employed in over 400 patients in the Stanford Gynecological laboratory It has been shown that outside of pregnancy the blood of patients may contain large quantities of the anterior hypophyseal "ovulation hormone" and thus suggest a hypersecretion of this gland (Fluhmann

29, 30, 32) Although this procedure as a clinical test is as yet in its infancy and it is not certain if it truly represents pituitary hyperfunction, it has been found reliable in conditions such as following castration and during pregnancy when a hypertrophy of the anterior hypophysis occurs, and conversely I have never obtained a positive result in a woman with normal menses

It seemed of importance to examine the blood of patients with hyperplasia, especially since this condition is prone to occur at the time of the menopause when a fairly high percentage of women have yielded positive results Ten patients have been examined, and in every instance the diagnosis had been established by a histological examination of the endometrium The ages were 23, 33, 38, 39, 40, 41, 44, 45, 49, and 50 respectively In one case, a woman of 44, the test proved positive, but in the other 9 it was definitely negative so that this feature cannot be considered as a characteristic of the disease

Of still greater importance are the studies which have been made on the presence of oöstrin in the blood or urine of these cases and we are chiefly indebted for this information to Frank, Zondek, and two investigators in Schroeder's clinic, Siebke and Schuschania Frank has examined the venous and uterine blood of 7 young patients with "puberty hæmorrhage" in whom cystic hyperplasia of the endometrium was demonstrated by curettage, as well as a few women in the premenstrual period who presented the same endometrial lesion The blood escaping from the uterus in these cases contained a demonstrable amount of female hormone, "thus differing strikingly from the uterine blood obtained in adult menorrhagias or metrorrhagias This probably signifies a high degree of ovarian activity" (page 238) In one of the young patients the urine also contained an unusually large amount of the hormone The examination of the venous blood, however, regularly showed an absence of even a single mouse unit in 40 cubic centimeters In this regard it is important to note that these blood examinations were apparently made following long periods of uterine bleeding, and the significance of the negative find-

ings will be appreciated later in the light of Siebke's results

Siebke has made 19 observations on 16 patients with glandular hyperplasia endometri following the technique described by Frank and Goldberger and employing 20, 40, or 60 cubic centimeters of blood. On ten occasions positive results were obtained and of these, 3 patients were not bleeding at the time of the examination, 4 had been bleeding for 9 days or less, and 3 for from 2 to 4 weeks. On the other hand, negative results occurred in 9 instances and in every case bleeding had been present for periods varying from 2½ weeks to over 3 months. It is thus seen that during the interval of non bleeding and during the first few days of bleeding, a large amount of œstrin is found in the circulating blood. Zondek (91) has also observed large amounts of œstrin excreted in the morning urine of such patients, especially during the amenorrhœic phase ("hyperhormonal amenorrhœa"), and an examination of the follicles in these cases showed that they exceed by 3 to 5 times the normal follicles in both size and hormone content.

The study of Sehusehania is of special interest in that it clearly demonstrates the association of œstrin production with hyperplasia of the endometrium in the postmenstrual period. The patient was 65 years of age, 7 years past the menopause and had a granulosa cell tumor of the ovary with hyperplasia of the endometrium. An estimate of the total hormone output over a period of 5 days preceding operation showed that 326 mouse units of œstrin were excreted in the urine and 619 in the feces. A similar study was conducted for 8 days a short time after the operation but only 158 mouse units were present. Two months after the operation an analysis of both urine and feces proved negative. He also found a demonstrable amount of œstrin in 50 cubic centimeters of blood obtained from a vessel in the capsule of the tumor.

OVARIAN HORMONES, HYPERPLASIA ENDOMETRII

The investigations which have been carried out in recent years on the ovarian hormones (Frank, E. Allen, Doisy, Aschheim, Zondek, Parkes, Corner, W. M. Allen, Hisaw, and numerous others) have served to point out

two very distinct effects on the endometrium which are normally manifested during the course of the menstrual cycle (see Fluhmann, 33). In the first place there is a set of changes initiated and maintained by œstrin (ovarian follicular hormone) which consists chiefly of an orderly growth of the glands and stroma from the permanent non changing basal layer, and at this time the stroma is dense and the cells are spindle shaped, while the glands are straight, with the lumina clearly outlined. Toward the middle of the menstrual cycle (tenth to eighteenth days), another factor comes into play, namely a second hormone manufactured by the corpus luteum (termed "progesterin" by Corner and his associates) which results in a definite transformation of the cells of the stroma and of the glands of the endometrium to constitute the so called premenstrual or pregravid phase. The cells of the stroma have now hypertrophied and become "decidua cells" while the glands are markedly tortuous, their lumina are irregular and indistinct, and they are filled with secretion.

It is of importance to interpret hyperplasia endometri in these terms, as they give a fundamental explanation for the manifestation of this disease, namely, an *overstimulation of the endometrium by œstrin and a complete absence of progesterin influence*. This conception is in keeping with Schroeder's teaching and the evidence for it is based on a number of important observations: (1) there is an extensive production of œstrin in women with hyperplasia endometri, (2) the absence of mature corpora lutea precludes the formation of progesterin, (3) œstrin is a growth stimulus to both endometrial glands and stroma, and in hyperplasia the endometrium has the histological characteristics which result from this type of stimulation, while (4) there is an absence of the endometrial changes which normally are produced by progesterin.

1. The massive production of œstrin ("hyperœstrinism") accompanying hyperplasia endometri is shown by the demonstration of large amounts of this substance in the venous and uterine blood, urine, and feces of these patients, as well as in the follicle cysts.

2. There is outstanding evidence that in hyperplasia the ovaries show functioning fol-

hicle cysts and a complete absence of mature corpora lutea. The finding of these histological structures in a few instances is not necessarily proof that they are functionally identical to the normal yellow body and are capable of producing progesterin. Wiesner and Crew have drawn attention to the occurrence of corpora lutea in lower animals without the manifestation of their characteristic effects on the uterus unless another factor is added. It is also important to remember that the normal human corpus luteum manufactures both oestrin and progesterin, and since these two substances are antagonistic it is conceivable that at times the oestrin may completely overshadow any progesterin influence.

3 The fact that oestrin is a powerful growth stimulus to the uterine mucosa in small laboratory animals, in monkeys (Allen and co-workers, 4, 5, 68), and in the human (Zondek, 90) has been conclusively shown by numerous investigations in castrates (Figs 12 and 13). It has also been found that the endometrium of monkeys given oestrin (Allen et al) shows the presence of only very early secretory changes in the glands. This is similar to the human endometrium normally seen during the stage of proliferation when the corpus luteum has not yet begun to function and in monkeys which have menstrual periods in the absence of ovulation and corpus luteum formation. The type of glands and stroma in hyperplasia is of this nature, except for the fact that they have undergone excessive growth, and in this regard it is of interest that following the administration of large amounts of oestrin Clauberg has observed a stratification of the cells in the uterine glands of the mouse which is not unlike that seen in the human in hyperplasia endometrii.

4 The endometrium in hyperplasia never shows fully developed pregravid changes in the glands and stroma, a process which is controlled by a second hormone of the corpus luteum (Corner and Allen, Hisaw and Leonard). The occasional occurrence of a gland with early secretory changes is not only explainable on the assumption that spontaneous healing is taking place (Schroeder 76, Runge), but as already pointed out, a similar early stage of secretion has also been found in

spayed monkeys as the direct result of oestrin stimulation.

CAUSE OF BLEEDING

The occurrence of "hyperoestrinism" may readily account for the marked growth activity manifested by the endometrium in glandular hyperplasia, but on the other hand it is necessary to seek further afield to discover any factors that may be held responsible for the hemorrhages accompanying this condition. In a previous study (Fluhmann, 31) the mechanism of bleeding from the endometrium was discussed, and it was pointed out that it may occur as the result of one of two distinct processes, namely, bleeding per rhexis or bleeding per diapedesis. The first of these, that is hemorrhage from actual injury to the vessels, may be brought about in one of several ways, namely, as the result of (1) a massive desquamation of the functional layers of the endometrium such as occurs in normal menstruation, (2) a localized necrosis of smaller or larger areas of the mucosa, (3) the rupture of an isolated superficial vessel, or (4) the formation of small pools of blood beneath the surface due to the rupture of a deep vessel and leading to a loss of continuity and the formation of an open wound.

It is felt that the chief local factor producing hemorrhage in cases of hyperplasia endometrii is the occurrence of tissue disintegration, although another possible cause is a traumatic injury to the large superficial vessels which are so frequently present (Seitz). In seeking for a hormonal explanation for the onset of necrosis, two different possibilities arise, and each is applicable to one of the two different clinical manifestations of the disease. There is first the group in which one finds a definite cyclical appearance of bleeding, and, second, those cases in which there is a prolonged, continuous or intermittent, hemorrhage lasting for periods of weeks or even months.

In considering the first group, one is tempted to draw a comparison with the cyclical hemorrhages of "normal menstruation," and there are several points of similarity besides the clinical demonstration of a "cycle." In both instances there is a spontaneous tissue destruction with a consequent growth and re-

pur The uterine blood in both cases contains large amounts of œstrin, although this is not met with in metrorrhagias from other causes (Frank, Siebke). And finally, it suggests a possible reversion to a primitive type of menstruation which has been described in various species of monkeys (Herpe, Herwerden, 45, Corner 16, 17, Allen, Hartmann), and which is not accompanied by follicle rupture and corpus luteum formation. The endometrium here corresponds to that seen during the stage of proliferation and the "menstrual flow" sets in accompanied by a tissue destruction and desquamation of the superficial layers.

This conception is particularly attractive because it affords a logical hormonal explanation for the onset of the hemorrhage. For many years investigators have sought to explain the uterine bleeding of menstruation by calling in some obscure "toxin" which would destroy the uterine mucosa. It would seem, however, that bleeding is produced in exactly the opposite way, namely, that it results because of the removal of ovarian influence after it has stimulated endometrial growth. This has been shown mainly in four ways: (1) Normal menstruation sets in at the same time that degeneration of the mature corpus luteum occurs. (2) The excision or destruction of a functioning corpus luteum or mature follicle is followed within a comparatively short time by uterine bleeding, both in humans (Frenkel, Psychlau, Halban and Koehler, Whitehouse) and in monkeys (Hartmann). (3) Although the peak of œstrin formation occurs a few days before menstruation, the blood of women at the time the menses set in does not contain a demonstrable amount of this hormone (Frank, Siebke), thus suggesting a diminution or a cessation of its production. (4) The discontinuance of prolonged administration of œstrin to human castrates (Zondek, 90) or to spayed monkeys (Allen and co-workers 4, 5, 68) results in uterine bleeding and the endometrial picture is of a breaking down of the mucosa which had been stimulated to active growth.

On the basis of this information a theory in regard to the whole clinical picture of hyperplasia endometrii might be conceived as follows: There is a cyclical development and atrophy of follicles which fail to ovulate. At

the time that the ovum is alive and the granulosa cells are active there is an overproduction of œstrin with a resultant hyperplasia of the endometrium. With the death of the ovum there is an atrophy of the follicle, a cessation of œstrin formation, and hence tissue disintegration in the uterine mucosa with consequent hemorrhage.

Such a theory would tend to support Meyer's interpretation of the ovarian findings and would not be at all inconsistent with that of Schroeder. However, there are unfortunately five serious objections. In the first place, although the process of tissue necrosis in hyperplasia has many points of similarity with the desquamation of normal menstrual endometrium, it is more irregular in that the disintegration takes place here and there, in smaller or larger areas, instead of producing a wholesale destruction. Second, Siebke found œstrin in the venous blood at the time hemorrhage set in, and since it is absent when normal menses occur it would seem that in hyperplasia there is not the same sudden cessation in the production of this hormone. Third, in the cases of "menstruation without ovulation" in monkeys the endometrium has not undergone an overgrowth as in hyperplasia in the human but on the contrary has developed to a less degree. Fourth, it is not applicable to the cases of hyperplasia which accompany ovarian new growths. And finally, it does not account for the second and largest clinical group of cases in which the hemorrhage is prolonged and irregular in occurrence instead of appearing cyclically.

The second possibility to account for the formation of necroses in hyperplastic endometrium is that suggested by Schroeder (76), namely, that, following prolonged and excessive stimulation to the endometrium, degenerative changes eventually set in which affect the blood vessels. As a result, numerous small thromboses with subsequent infarction and necrosis take place and produce irregular or continuous uterine bleeding. Although there is as yet no experimental data which clearly demonstrates that the constant stimulation by œstrin leads to this effect, this explanation is strongly supported by both clinical observation and histological investi-

gation. It readily accounts for the non-cyclical hemorrhage which occurs in two-thirds of the patients with hyperplasia endometrii and is particularly applicable to those cases accompanying ovarian new-growths during the post-climacteric period.

It would seem that this aspect of the problem must remain *sub judice* for the present. However, the co-existence of both the factors discussed above, namely, necrosis due to cessation of oöstrin stimulation and due to *prolonged* incessant stimulation, must be kept in mind as a possibility.

ETIOLOGY

Although some progress has been made in determining the nature of hyperplasia endometrii nothing definite is known as yet regarding its etiology. It has been conclusively shown that this condition *per se* has nothing to do with infection, and although it is still stated that local pelvic factors which induce a hyperemia may lead to hyperplasia endometrii the evidence advanced has not been very convincing. As has been outlined in this paper, the endometrial changes merely represent a response to an ovarian dysfunction, and the problem is to determine whether the ovary is the primary organ involved or whether it is affected by some external influence.

In view of the work of Evans, Smith, Engle, Aschheim, and Zondek demonstrating the "ovary-stimulating" properties of the anterior hypophysis one's attention is at once directed to this organ. However if the anterior lobe is directly concerned with hyperplasia endometrii, it is impossible as yet to state whether this involvement is in the nature of a hyperfunction, a hypofunction, or a disturbance in the relationship of the two hypophyseal sex factors.

Hofbauer (51) has recently found that following either bovine anterior hypophyseal implantations or the administration of an alkaline extract of this gland to mature guinea pigs a large number of atretic follicles are found in the ovaries and the uterine mucosa gives evidence of marked proliferation. On the basis of this finding, he has advanced the theory that a hyperfunction of the anterior lobe is responsible for hyperplasia endometrii, and

suggests the name of "hyperplasia endometrii pituitaria" for the condition. This contention is also supported by the fact that at the time of the menopause when hyperplasia most frequently occurs, large amounts of the anterior pituitary "ovulation" hormone are often found in the blood (Fluhmann, 32) and urine (Zondek, 92) of women, while Hofbauer (49) has reported that X-radiation of the hypophyseal area with a resultant diminution in the activity of the gland has a beneficial effect in certain cases of abnormal uterine hemorrhage.

On the other hand there are several objections to the theory that a simple hyperfunction of the anterior hypophysis leads to hyperplasia endometrii. (1) It is doubtful if in this problem experiments on animals with an oöstrous cycle can be accepted as directly applicable to humans with a menstrual cycle. As pointed out by Wiesner and Crew and others, certain laboratory animals (rats, mice, guinea pigs) are "diphasic" in that normally the sex cycle is controlled solely by oöstrin (the "oöstrual" phase), while the second ("reproductive" phase) which is the result of progestin stimulation, occurs only in the case of gestation or pseudo pregnancy. On the other hand, in the human cycle both phases are represented since a pregravid transformation ("pseudo-pregnancy") occurs before each normal menstruation. Thus an ovarian stimulation with anterior lobe substances may merely intensify the oöstrual change in the uterus of diphasic animals and result in a hyperplastic uterine mucosa, but this does not prove that there is an abeyance of the progestin element as well, a feature which is prominent in the human hyperplasia endometrii. It has in fact been shown that the administration of anterior hypophyseal fluid aids the placentoma reaction of adult vaginal rats (Teel, Brouha), thus suggesting that instead of suppressing the "reproductive" element of the cycle in these animals, it may stimulate it. (2) There are individual species variations in ovarian response even in different laboratory animals. For Smith and Engle have shown that prolonged stimulation of mature mice and rats with anterior lobe implants produced quite different results. In the rat ovar-

ries there were numerous atretic cysts and theca lutein cysts, but these were not noted in mice. In both instances corpora lutea were formed and the animals would mate (3). There is some evidence that an excessive production of the sex hormones of the anterior lobe may lead to quite a different result from hyperplasia, namely, to an accelerated formation of normal follicles and corpora. Smith and Engle found this to be the case in adult mice treated with implants over a prolonged period, and it has been shown elsewhere (Fluhmann, 32) that in the human there occur certain conditions in which the examination of the blood shows the presence of large amounts of the anterior pituitary "ovulation" hormone, and clinically the patients are found to have too frequent and too profuse menses. In these cases follicle ripening, ovulation, and corpus luteum formation occur and the mucosa conforms to the normal cyclical changes. It is thus not a hyperplasia endometrium as understood in this study but a "simple hypertrophy of the endometrium" (4). And finally, the examination of the blood of 10 patients with hyperplasia endometrium has only demonstrated the presence of large amounts of the anterior lobe sex hormones in one instance, and it would seem that if this condition were due to a pituitary hyperfunction one would have obtained positive results more frequently, as has been the case in women following castration or during pregnancy.

It would seem that an accurate scientific explanation for the occurrence of hyperplasia endometrium will be given only when more is understood regarding follicle rupture and corpus luteum formation. It is also probable that a more complete knowledge of the factors concerned in the "menstruation without ovulation" of monkeys will be of much significance.

TREATMENT

The methods of treatment which have been employed for the patients of this series are in keeping with the recommendations previously given by most authors on the subject, and do not offer anything unusual. The procedure of choice in younger patients has been to perform a curettage. In a group of 17 who were

seen for a period of at least 1 year following the curettage it was found that 7 were completely relieved of their symptoms, 3 within 2 months of the operation had a short period of bleeding which cleared up spontaneously and the patients were well afterward, 2 were well for a few months but had a recurrence within 1 year, 3 were unimproved, and in 2 no interval history was available but it is known that the bleeding was again present 2 years after operation. In the case of recurrences it is generally recommended to repeat the curettage, but if this is ineffective and the bleeding becomes altogether uncontrollable it may be necessary to perform a hysterectomy. In one instance the patient had a retroversion uteri with symptoms. A curettage was performed, followed by a suspension of the uterus and during the laparotomy numerous small cysts in both ovaries were punctured with the thermocautery. The patient has remained well for 2 years but it is not felt that this method of treatment is to be recommended.

The treatment of choice in patients of the menopausal age is to perform a diagnostic curettage and give an intra uterine application of radium varying between 1,200 and 1,500 milligram hours. This procedure in our hands has given universally good results.

Although a number of reports have been published regarding the use of various hormone preparations in this condition this type of therapy with biologically active products is as yet in the experimental stage. It is possible that the development of an extract of the "luteinization" factor of the anterior lobe or the placenta will be of value. Owing to the fact that this disease is characterized by an overproduction of oestrin, it is illogical to administer this ovarian hormone to patients with hyperplasia endometrium (Schroeder, 77; Siebke).

SUMMARY

Hyperplasia endometrium is the name given to a characteristic lesion of the endometrium which should not be considered as a purely local change but as part of a definite clinical pathological entity.

It was found in 2.8 per cent of the last 1,700 hospital admissions on the Stanford Gynecologic

logical service, and accounted for 12.2 per cent of patients in a series of 507 women with abnormal uterine hemorrhage.

It may occur at any time during the active sexual life of women and has been observed in the postclimacteric period, but the majority of cases are found just before and during the menopause. Approximately 75 per cent of the patients were multiparae.

The outstanding symptom of the disease is uterine hemorrhage, which is manifested mainly in two ways: (1) Periods of profuse bleeding occurring at cyclic intervals, and (2) prolonged, continuous or intermittent, hemorrhages.

No relation between hyperplasia endometrii and systemic disease was established, but in about 30 per cent of the cases, there was an associated pelvic condition.

The endometrium is characterized by a marked hyperplasia of both glands and stroma. There is an absence of the corresponding cyclical changes of menstruation and a disorderly arrangement of the glands, of which 3 main types are seen: (1) glands lined by a single layer of cylindrical epithelium, (2) cystic glands with a low cuboidal epithelium, and (3) glands with a stratification of the cylindrical epithelium. In specimens obtained at the time a patient is bleeding may be seen in addition areas of necrosis, thrombosis of blood vessels, and infiltration with leucocytes and lymphocytes.

Epidermalization is occasionally noted and may give rise to confusion with carcinomatous changes. A co-existence with carcinoma has been described.

The ovaries of patients with hyperplasia endometrii characteristically show the presence of cystic ripening follicles, atretic follicles, and theca lutein cysts, and there is an absence of mature corpora lutea. A number of cases with ovarian new growths have previously been described, and one additional instance of granulosa cell carcinoma is herein reported.

Functional studies have demonstrated an excessive production of oestrin during the course of this disease, and the name "hyper-oestrinism" is suggested to describe this condition. In only one case out of 10 was it pos-

sible to find large amounts of the anterior pituitary sex hormone in the blood.

Evidence is advanced suggesting that hyperplasia endometrii is the direct result of an overstimulation of the endometrium by oestrin and the complete absence of progesterin influence.

The chief local factor producing hemorrhage is the occurrence of areas of tissue disintegration. Two possibilities regarding the induction of necrosis in the endometrium have been discussed, namely: (1) a sudden cessation of oestrin production, such as would occur consequent to the death of the ovum and atrophy of the follicle, and (2) a prolonged excessive oestrin stimulation such as would result from the persistence of cystic ripe follicles.

The etiology of this disease is as yet obscure but it is evidently the result of an endocrine disorder rather than a local pelvic condition. The possible involvement of the anterior hypophysis is considered.

The use of repeated curettages in younger patients and intra-uterine radium applications for women of the menopausal age are recommended as the most satisfactory methods of treatment evolved to date.

My thanks are due to Professor Robert Schroeder for his kindness in personally demonstrating many of his valuable specimens of hyperplasia endometrii and for permission to study the Kiel material to Doctor Harald Siebke for information regarding his studies on oestrin, and to Mr. Pierre Lascegues for his technical services.

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THE INTERRELATIONSHIP OF THE PITUITARY TO THE ENDOCRINE SYSTEM WITH REMARKS ON THE TREATMENT OF PITUITARY DISORDERS

BASED UPON OBSERVATIONS IN A SERIES OF THREE HUNDRED AND THIRTY-FOUR CASES¹

CHARLES H. FRAZIER, M.D., Sc.D., F.A.C.S., PHILADELPHIA

From the Neurosurgical Clinic of the University Hospital, Philadelphia

REVIEWING the notes of some 334 cases of pituitary lesions in the human subject, one is impressed at once with the extraordinary variations in the clinical expression of the disordered gland. I doubt whether any gland or organ of the body presents so many problems for study and observation and from so many angles. Of course as surgeons, we have a very vital interest in the pituitary body since of intracranial tumors *en masse*, tumors of this structure comprise almost 20 per cent. But, of the clinicians, the internist, the obstetrician, the ophthalmologist, the neurologist in their every day rounds cannot escape the practical problems which concern the pituitary body, and of the laboratory group, the anatomist, the chemist, and the physiologist, interested in research, find here a fascinating field for investigation.

It is not surprising, because of the many ways in which the hormones of the pituitary body influence the function of other glands and vice versa, that the clinical syndromes are so varied and versatile, and the problems involved offer so many avenues of approach and interest.

It has been claimed recently that the anterior lobe possesses two hormones, one a growth hormone and one having maturity provoking function (Loeb and Bassett). Further differentiation has been established in that the growth factor is believed to be a product of the eosinophilic cells while the basophilic cells are related more specifically to the gonads. One of these hormones stimulates growth of the thyroid gland.

The information available from the experimental laboratory as to the interrelationship between the pituitary and the other glands of the endocrine system is abundant, much more abundant than the available information as to any other gland. To emphasize the im-

portance of the pituitary from this angle, may I venture to recite a few of the observations which have been made in the past five years alone.

Perhaps the most intimate relationship and the most constant is with the thyroid gland. Thyroid deficiency conditions a consistent hypertrophy of the hypophysis in the male though not in the female. The size and the activity of the pituitary is specifically related to the activity of the thyroid, when this exceeds the usual limits in either direction, although its growth response to thyroid deficiency does not parallel the body as a whole (Hammett). It has been said that the anterior lobe is the specific agent which stimulates the thyroid gland (Uhlenhuth). Partial extirpation of the thyroid and adrenals in the parents will be followed by an increase in the pituitary to two or three times its normal size in the offspring (Seitz and Leidenius).

It has been suggested that the determination of pituitary sensitivity may be of aid, as with adrenalin, in the diagnosis of hyperthyroidism (Herzsum and Pogany).

Embryologically, of course, this relationship is very close, both structures being formed from a mass of epithelium split off from the pharynx. It might be of interest to note that a larger mass goes to the thyroid in women than in men. Whether this has any relationship to the greater frequency of various forms of goiter in women than in men is an interesting speculation (J. H. Hutton).

Definite and constant as the relationship between thyroid and pituitary has been proved in lower forms of life, it has been a matter of surprise to me that in the various dysfunctions of the pituitary gland in the human, one so seldom finds any evidence of thyroid involvement. In my entire series I recall but 2 or 3 cases of goiter, one of them

¹Read at the annual meeting of the Baltimore City Medical Society, Baltimore, Maryland, April 4, 1930.

a case of Basedow's disease. Whether the accession in weight characteristic of pituitary hypofunction can be attributed to hypofunction of the thyroid is a matter of speculation. Redlich believes the vegetative nervous centers and the endocrine chain are intimately related and interactive, the vegetative centers exerting a regulating and activating influence on the endocrine system, and the secretion from the pituitary in turn influencing the vegetative centers.

Many observations have been made on the effect of removal of the parathyroids, but the results are not nearly so constant as after thyroidectomy. Certainly there is no specific growth relation between the parathyroid and the pituitary structures.

From the clinical viewpoint one would expect evidence of interreaction between the pituitary and gonads. We have so constantly observed that in the female one of the earliest symptoms of pituitary disorder, antedating by many years any other suspicious evidence, is amenorrhœa. Impotence in the male, while in a series not infrequent, usually appears as a later symptom and is not observed until a diagnosis may be established by other symptoms of longer duration.

In a review of 50 consecutive cases of pituitary tumors from my clinic, Puestow found in every case but one of adenomata in women amenorrhœa was a symptom and frequently the first symptom. The frequency of amenorrhœa suggests the residence in the anterior lobe of an inhibitory hormone. In fact Zondek is inclined to believe that the primary hormones for the sex organs is a pituitary product. In this series of 50 cases, of the males in one half there was loss of libido and potency irrespective of the character of the tumor.

In the lower animal castration causes an increase in weight and volume and characteristic histological changes in the pituitary, and after removal of the ovaries the eosinophils are increased. It has been said (Siegert) that the secretion of the posterior lobe of the pituitary is regulated by the ovary (Berblinger). There is no question in the lower animals that during pregnancy the anterior lobe of the hypophysis hypertrophies (Seitz) and the relationship between the pituitary and preg-

nancy in the human have long been recognized. The secretion of the ovary has a definite specific stimulating effect in promoting pituitary secretion (Dixon and Marshall).

Is there an interassociation of the action of the adrenals and the pituitary? This question arose in one of my series in which there were signs of acromegaly and marked hypertension. This was a case of pituitary dysfunction with hypertension and thyroid intoxication.

Mrs J. L. C. aged 45 years was admitted to the Neurosurgical Service December 11, 1913, complaining chiefly of headache, enlargement of hands, of the jaws and thickening of the lips and tongue. The case was diagnosed as acromegaly. Her systolic pressure varied from 180 to 240. She was placed on pituitary extract. Later she developed signs of exophthalmic goiter with exophthalmos, certain nervous phenomena, and enlargement of the thyroid gland. The patient was under observation at intervals until she died in June, 1914.

Experimentally the removal of the adrenals with the thyroid causes a pronounced increase in the size of the hypophysis, and after bilateral adrenalectomy (Lehmann) there is a marked œdema of the pars nervosa. There is unquestionably a functional relationship between the pituitary and suprarenal cortex as might be expected on embryological grounds. The suprarenal cortex, differing from the medullary portion, is derived from the mesothelium as are the sex glands. Aplastic states of the pituitary are concomitant with aplasia of the suprarenal cortex and hyperplasia of one with hyperplasia of the other (Voelklig).

There has been some question as to whether there is such a thing as antagonism between the endocrine glands. The thyroid and pituitary are regarded by many as synergists and directly opposed to the pancreas. Others emphasize the sensitizing action of pituitrin on adrenalin and consequently the antagonistic action of pituitrin on insulin. The pancreatic secretion increases after insulin and decreases after pituitrin injection. It has been assumed that hypopituitarism produces a hypoparathyroidism and, vice versa, a rise of insulin in the blood increases the quantity of pituitrin as without this, protective correlative hypoglycæmia and death would occur.

Of the unusual manifestations of pituitary disorder in the human is pituitary cachexia or

Simmond's disease In my clinic there was one very striking example of this in a boy of 15 years

J B T, aged 15 years, male, was referred to the Neurological Clinic by Dr W G Spiller and Dr J W McConnell, on December 17, 1925, complaining of paroxysmal headaches and vertigo. Family history was negative. He had had most of the children's diseases, and his growth up to his ninth year had been undisturbed. Since that time there had been little if any growth. From the age of 9 years (1919) until 2 years ago (1923) he had been apparently well. He then began to have headaches, referred to the occipital region, which occurred at intervals at any time of the day, were of variable duration, and caused a queer sensation in the head, which he called dizziness.

Physical examination revealed a small, thin boy with dry, rough skin which suggested dehydration although he admitted drinking a fair amount of water. He had the facies of an adult. The upper extremities were thin and ill developed.

Pituitary stigmata The external genitalia were underdeveloped. There was no axillary or pubic hair. The thyroid was not palpable. In the spring of 1925, the patient weighed 96 pounds but since that time he had lost from 25 to 26 pounds.

A roentgenogram showed an abnormal shadow, roughly circular and an inch in diameter immediately above the posterior clinoid process, more than half of it to the left of the median line. The shadow had the density of bone.

On ophthalmologic examination bilateral partial secondary atrophy was noted.

Preliminary diagnosis pharyngeal duct cyst.

Operation was done December 19, 1925. The first stage of a right transfrontal craniotomy was performed, under ether. The wound was closed without drainage. December 24, 1925, second stage, transfrontal craniotomy. The flap was reflected and the suprasellar region readily exposed. At once the wall of the cyst appeared with its bluish discoloration behind the chiasm. It filled the entire space behind the optic tracts and chiasm. The wall of the cyst was incised, and the fluid content was evacuated. A tumor mass, partly calcified, still remained, and as much of this as was in contact with the optic tracts and chiasm was removed piecemeal. There was a hard, calcified mass at the base of the tumor, the shadow of which showed in the roentgenogram.

One naturally wonders whether the extreme emaciation one sees in this disease may not owe its origin to the direct effect of the loss of pituitary secretion upon the pancreas and the resulting hypo-pancreatism. Certain it is that with the loss of pancreatic secretion, as sinus drainage from the upper intestinal tract, there is a rapid and alarming emaciation.

The metabolic disturbances in the pituitary subject are frequent observations though variable and inconstant. In my own series I have been impressed with the fact that when the metabolic rate is not normal, irrespective of the lesion, the rate is below rather than above normal. But the factor responsible for the disturbance in metabolism is not at first apparent. It has been said that in animals the pituitary reacts to many interventions affecting general metabolism, such as thyroidectomy, castration, adrenalectomy, and pancreatectomy and to combinations of these qualitatively in the same way (Poos).

Innumerable experiments upon the result of pituitary ablation have been recorded with results not altogether in harmony. The conflict is attributed to two factors—one, the uncertainty as to whether every vestige of the gland has been removed in the experiment, the other, the question as to whether at the operation damage may not have been inflicted upon the tuber cinereum to which many symptoms, hitherto attributed to the pituitary, have been ascribed. By many it is said that the removal of the pituitary experimentally results in the development of the Frölich syndrome. According to Smith an operation has been perfected by which both lobes may be ablated and an unvariable syndrome, he says, follows: inhibition of growth in the young, cachexia in the adult, atrophy of the thyroids, adrenal, cortex, and genital system. From the clinic we might cite many illustrations of the effect of atrophy or destruction of the pituitary gland in lesions of long standing. Dwarfism, adiposity, sexual apathy, lethargy, in some cases somnolence are the more common expressions.

The differentiation between pituitary lesions of surgical interest and those not presenting indications for operative intervention has for the present been based upon the presence or absence of visual disturbances and in a small number of pituitary headache. Whether in the future resort to surgery will be had to arrest acromegaly or the symptoms of the Frölich syndrome is a question.

In a very general way, we may recognize two groups of dyspituitarism, one with and one without evidences of gross lesions. I

have seen a number of cases, especially in adolescents with unmistakable evidence of pituitary dysfunction in which the sella turcica is not enlarged. It is in this group particularly that the question of glandular feeding comes up for consideration.

Whatever the experience of the clinic, experimentally interesting results have been recorded. By some (Schwartzbach and Uhlenhuth), intraperitoneal injections of the anterior lobe into larva (urodeles) hastened metamorphosis, probably as a result of thyroid stimulation, by another (Chamberlain), the injections of anterior lobe extracts into rabbits caused definite histological changes in the liver, a number have found feeding of the anterior lobe had a stimulating effect upon growth. For some reason the effect upon invertebrates differs from that of the vertebrate (Thompson).

In the human a number of observations have been made. In one a favorable result was reported in a case of hypopituitarism (Morris and Weiss), in another increase in the specific dynamic response to foods following the administration of the anterior lobe (Kestner et al). One observer failed in a normal subject to influence basal metabolism or the respiratory quotient after oral administration of anterior lobe (Missal and Johnston).

Other observers record in children with infantilism and defective growth considerable improvement from glandular therapy (Gardner Hill and Smith). Striking improvement in a case of Addison's disease followed the administration of two grains of the whole gland (Ibotson), and this might be cited as another instance of the stimulating effect of the pituitary upon the adrenals.

There is no question despite the variable results in the laboratory that in certain cases favorable results have been obtained in my clinic from glandular feeding. For illustration I might cite the following case of pituitary dysfunction without evidence of tumor, under observation 4 years with loss of 40 pounds in weight and disappearance of lethargy, following glandular feeding.

G. A., aged 21 years, admitted to the Neurosurgical Service of the University Hospital February 7, 1923. Diagnosis, dyspituitarism.

Before marriage the patient weighed 125 pounds one year afterward 160 pounds and today 190 pounds. She had been operated upon September 14, 1922 for appendicitis. She had frequent headaches, bitemporal and frontal, was lethargic and mentally sluggish, sleepy most of the time, hyperemotional, worried about and often cried over trivial matters. Except for the adiposity the physical examination was entirely negative. The sella turcica was of normal dimensions. Blood pressure 105/70 fields normal, serology negative, blood and urine analyses normal. Basal metabolism minus 15.

From 1924 to 1927, she received daily, with certain remissions, 6 grains of pituitary extract and 1/2 grains of thyroid extract. When the treatment began she weighed 199 pounds and at the conclusion 150 1/2 pounds, a loss of approximately 40 pounds. In addition the lethargy had disappeared and there had been a return of energy and ambition. The hyperemotionalism and irritability disappeared.

A dramatic example of glandular feeding in a case hitherto reported (31) might be cited. The patient, a young man with a pharyngeal pouch cyst was transferred from a state of somnolence to an alert subject, from a bed ridden to an active state. At other times I have seen a marked rise in the metabolic rate from a combination of pituitary and thyroid feeding.

To avoid misunderstanding it should be said that in all these cases the administration of pituitary extract was always combined with thyroid extract. Some years ago I found the addition of thyroid extract seemed to fortify the action of the pituitary extract. Whatever the effect of glandular feeding in selected cases I found, many years ago, as one might well expect, that glandular extracts inevitably failed to reduce the size of the lesion.

So far as I know no attempt has been made in the human to treat dyspituitarism by glandular implantations. In the laboratory, certain effects have been observed, regeneration of the atrophied thyroid in certain species (Allen), a specific and highly favorable action on the growth of the ovary (Zondek and Aschheim), direct action upon the gonads (Smith and Engle). Evans and Simpson (6) found that anterior hypophyseal implants produced ovaries 6 times the weight of the ovaries in animals receiving the same implantation with normal adult female hypophyses. Analogous results were obtained in the male and it is the germ cell component of

the testes rather than the interstitial tissue to which the anterior hypophysis is directly related. These experiments would indicate a storage of the sex hormone in the anterior hypophysis after castration.

To apply the implantation method of the laboratory to the treatment of dyspituitarism in the human is impracticable since to obtain positive results implants must be made daily. The variable results that have been obtained in the past with glandular feeding were due in part to the lack of standardization in the products on the market and until a standardized reliable extract is available the results of glandular feeding will not reach their maximum efficiency.

From what has been said it is apparent that glandular feeding or implantation is inappropriate in those cases in which operative interference is indicated for the relief of pressure, that the use of glandular extracts has been effective in combating the effect of hypopituitarism not only in the presence of gross lesions of the pituitary body but in the presence of pituitary dysfunction without evidence of gross lesions no one can now dispute.

There is, I believe, a field of usefulness for radiation, limited though it may be. I am well aware that there may be contradictory evidence as in the reports from the laboratory of Poljaschuk. In studying the effects of pituitary deficiency upon the genital system radiation of the pituitary body has been tried as a substitute for its operative removal. The observer was unable by irradiation of the pituitary to cause any regressive changes in the genital system and as a result drew the conclusion, to me difficult of maintenance, that there was no specific relationship between the pituitary and genital system.

Whatever weight one may attach to this laboratory observation, there is incontrovertible evidence from my clinic as from others, that radiation does have a beneficent effect in certain selected cases. I say in selected cases because obviously radiation should not be expected to influence lesions essentially cystic. Hence it is not indicated when we are dealing with pharyngeal duct lesions, so frequently largely cystic. But there remains the larger group of primary pituitary adenomata.

Here with perfect propriety one may approve radiation under certain restrictions. It has been my practice to recommend treatment by radiation whenever visual disturbances are not too far advanced. The presence of a bitemporal hemianopsia, the degree of field distortion, need not be the criterion. One may have a complete bitemporal hemianopsia from pressure alone without as yet permanent damage to the optic nerve. With marked loss of visual acuity and signs of well advanced optic atrophy, the time for radiation has passed. Many of our patients when they apply for treatment are already blind in one eye and to save vision in the other one should not defer operation.

As a matter of fact, we have but three examples to present from our own series with positive results from irradiation. Without citing these cases in detail, suffice it to say that of these three the results in two were only transitory in effect. Eventually it was necessary to resort to operation to conserve vision. In but one have the effects of X-ray treatment been permanent, if by permanent one may be content with a period of 5 years of quiescence. The treatment in this case was begun in February, 1926, and at the present writing there are no signs of progression.

There are so many exact methods of establishing a diagnosis in primary pituitary lesions that this question may be passed by. I might refer only to the information that may be derived from the encephalogram, concerning which I have not seen reference elsewhere. For example, in a patient with recurrence after operation in another clinic an encephalogram revealed the following: obliteration of the cisterna chiasmatis, displacement upward of the third ventricle, encroachment on the anterior horns of the ventricles without displacement of the ventricular system laterally. These findings could all be ascribed to a lesion of the pituitary body and one of considerable dimensions, evidently well beyond the limitations of the sella turcica.

There are then but three methods of dealing with the pituitary lesions: glandular feeding, radiation, and operative intervention. The indications for surgical intervention are well defined, progressive loss of vision in most

cases, in a few, intolerable pituitary headache. What should be the method of approach? One must choose between the transsphenoidal route, popularized by Hirsch of Vienna, and the transfrontal route. With me the pendulum has swung back and forth. My initial experiences were with the transfrontal route, when Hirsch described his transsphenoidal route. I used this method exclusively for several years with considerable satisfaction and a mortality of 3.4 per cent. From many points of view the operation has much in its favor, but familiar with the restricted opportunities for dealing with the lesion, one cannot but be impressed with its limitations. At most one can by the transsphenoidal route incise the capsule with a crucial incision and evacuate the contents. Recurrences are therefore inevitable and the measure of relief may be disappointing for reasons easily appreciated. If as in many cases the capsule of the lesion is firm and resisting after evacuation of the contents the capsule will not collapse and pressure on the overlying chiasm and optic nerves persists. It was chiefly for these several reasons that I returned to the transfrontal method.

For various reasons the operation for exposure of the pituitary tumor presents problems differing from those of the conventional craniotomy for brain tumors in general. In the first place one must plan the operation from the cosmetic viewpoint with the least disfigurement as its objective. With this in mind the customary osteoplastic flap is not employed, but in its place I now fashion the scalp flap and bone flap separately. The scalp flap is reflected forward, the bone flap with temporal muscle attached, temporalward. This technique, from the cosmetic point of view, gives the same degree of exposure as by the original transfrontal osteoplastic method.

There are very definite and distinct indications for these several methods of treatment, glandular feeding for pituitary dysfunction, without pressure phenomena, radiation for primary pituitary lesions, particularly adenomata, with evidence of early pressure signs but without signs of advanced optic atrophy and finally operative intervention when vision is threatened or headache intolerable. The

operative risk, now 5 per cent, will I believe in time be reduced materially and the measure of relief in so far as concerns vision will depend altogether and entirely upon the presence and the degree of optic atrophy. Field distortions can be completely abolished and vision wholly restored, if the operation be not delayed as is now so often the case, until atrophy of the optic nerves, one or both, is established. The transfrontal procedure, as I have described it, is now accepted and approved and may be resorted to with reasonable assurance of success whenever the operation is not untimely.

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THE PATHOGENESIS OF ACUTE DILATATION OF THE STOMACH¹

LESTER R DRAGSTEDT, PH D, M D M LAURENCE MONTGOMERY, MS, M D, JAMES C FLIIS, M D, AND WARREN B MATTHIJS, MS, M D, CHICAGO

From the Department of Surgery of the University of Chicago

THE purpose of this paper is to call attention to a new interpretation of the etiology and pathogenesis of acute postoperative dilatation of the stomach made possible by some recent studies on the physiology of gastric and pancreatic secretion. The outstanding features of the disorder in question are the sudden and often excessive enlargement of the stomach, the regurgitation of large amounts of fluid, the progressive dehydration with suppression of urinary secretion, the occasional symptoms of tetany, and finally collapse and death if adequate treatment is not instituted. The condition is quite probably of frequent occurrence but is unrecognized except in extreme cases. It is likely that every abdominal operation with extensive stimulation of visceral afferent nerves is followed by varying degrees of gastric relaxation, but no untoward symptoms appear and it is unnoticed. It is significant that those surgeons who are interested in this problem find many of these cases in their practice. Most of the reported cases have followed operations under general anesthesia and it is probable that this postoperative group comprises from 60 to 70 per cent of all cases (Borchgrevink, 1913, Doolin, 1918). However, the disease has been reported as developing during the course of, or convalescence from, severe and wasting diseases (Herrick, 1906), following childbirth, after falls and injuries, following the removal of body casts, catheterization of the ureters, blows to the abdomen, after errors in diet associated with sudden overloading of the stomach, and in persons with spinal deformities of various kinds (Conner, 1907). It is this wide variety in the apparent exciting factors that has made the analysis of the pathogenesis of the disease so difficult and accounts for the present multiplicity of views.

The striking finding in postmortem examinations is the dilated stomach which often is extreme so that it may fill the entire abdominal cavity and even extend into the pelvis. Except

in cases treated by repeated gastric lavage, the contents of the stomach are gas and a thin greenish, greenish-brown, or brownish-black liquid, which is usually odorless and practically neutral in reaction. As would be expected from the great dilatation, the walls of the stomach are exceedingly thin, the mucous membrane pale, but there is no evidence that the distention has interfered with the blood supply to the gastric wall. The greatly distended stomach has been mistaken for a cyst at operation and evacuated (Brown, 1899). If the pathologist has this condition in mind at the autopsy and accordingly makes a special effort to determine the point before the abdominal viscera are disturbed the duodenum will usually, possibly always, be found compressed to varying degrees at the point where it passes over the spine. Occasionally a reddened line or groove has been found where the stretched mesentery and its vessels have pressed upon the duodenum. In most cases evidence of such marked compression is absent and the examiner's finger can easily overcome the degree of occlusion found. The duodenum proximal to this site is usually distended somewhat but it is not capable of any dilatation comparable to that seen in the stomach (Dragstedt, C A, 1929). The mucosa of the duodenum may be entirely normal, or hyperemic and even hemorrhagic in places. It does not, however, present the usual picture of a strangulated area of jejunum or ileum.

The occurrence of acute gastric dilatation during the course of an abdominal operation and even with the patient in the Trendelenburg position, as reported by Novak (1921), suggests that the mechanism is probably a nervous reflex. This theory is not new. Novak (1921) credits Brinton (1859) with being the first to suggest that a gastric paralysis results from impulses conveyed to it via the extrinsic nerves, and Novak himself believes that this theory more than any other accounts for the immediate etiology of the condition. Recent

¹ This work has been conducted under a grant from the Douglas Smith Foundation for Medical Research of the University of Chicago. A preliminary report of this work was published in the *Proc. Soc. Exper. Biol. & Med.* 1919 XLV 236-237.

work has greatly clarified our conceptions concerning the mechanism of this reflex inhibition of the alimentary tract. The experiments of Carlson and Luckhardt (1921) demonstrate that it is possible to obtain visceral reflexes from the stimulation of either somatic or visceral sensory nerves. While both motor and inhibitory fibers are present, the predominant effect of the vagus on the tonus of the mammalian cardiac and pyloric sphincters is inhibitory and on the stomach proper is motor. The opposite situation obtains in the effect of the sympathetic fibers from the celiac plexus. While both motor and inhibitory efferent fibers are likewise present, the predominant effect of the sympathetic fibers on the tonus of the cardiac and pyloric sphincters is motor and on the stomach is inhibitory. Relaxation of the stomach with contraction of the cardia and pylorus has been observed by one of us (L. R. D.) following direct stimulation of the peripheral splanchnic nerves in cats under light ether anesthesia or reflexly through stimulation of many of the abdominal viscera and of sensory fibers in the sciatic nerve. The nervous pathways involved in these visceral reflexes are indicated in the diagram in Figure 1. Relaxation of the stomach but to a lesser extent has been observed after section of the vagi. Most of the cases of acute dilatation have occurred following laparotomy, and of these operations on the gall bladder and female generative tract seem more prone than others to cause the trouble. Operations upon the stomach itself rarely give rise to an acute dilatation. The occurrence of acute dilatation following injuries and extra abdominal operations, such as those on the extremities and face, indicates that profound stimulation of somatic as well as visceral sensory nerves may bring about reflex inhibition of the stomach. The experimental evidence is thus quite adequate to show how the trauma incident to laparotomy, or operative injury to any part of the body, or childbirth, might occasion marked inhibition of the gastric tonus through reflex inhibition of the vagus and stimulation of sympathetic nerves to the stomach. However, the degree of relaxation which is seen in some cases of acute dilatation in man cannot be readily produced in laboratory animals by any amount

of sensory stimulation. This may be referable to a species difference or it is possible that some depression in the peripheral gastric motor mechanism is necessary. There is, moreover, direct experimental evidence as well as clinical observation that chloroform or ether anaesthesia depresses the gastric tonus (Payer, 1910), and this no doubt may be an important contributing factor in many cases. Most of the postoperative cases reported have followed general anaesthesia.

The conception of a gastric paralysis in the usual sense through interference with its motor innervation as claimed by Canon and Hallion (1893) and apart from reflex or toxic depression of tonus is probably erroneous. The work of Goltz, Gaskell, Carlson and Luckhardt, Alvarez, and many others indicates that the alimentary tract possesses a peripheral automaticity similar to that of the heart or amphibian lung, and a section of its extrinsic nerves does not produce gastric paralysis any more than section of the vagus or sympathetic branches to the heart results in paralysis of the cardiac musculature. In the course of other work, one of us (L. R. D.) has repeatedly sectioned both vagi and vagi and splanchnics in dogs without producing any evidence of gastro intestinal paralysis.

In those cases in which acute dilatation of the stomach has come on during the course of an abdominal operation or has been immediately recognized, the content of the stomach is chiefly gas. Analyses of this gas have not been made but it appears quite likely that the major part of it consists of air that has been swallowed during the reflex movements often associated with a beginning anaesthesia (Lee, 1916). A part, doubtless, is gas from the intestines and ether vapor excreted into the stomach. At all events, there is sufficient present to balloon the relaxed stomach often to an amazing degree. Even in severe cases, however, the gas is under greater than atmospheric pressure and it readily escapes when the stomach tube is passed.

Perhaps the question that has given rise to most discussion in considerations of the mechanism of acute dilatation of the stomach is the presence and significance of an associated obstruction to the duodenum. Rokitansky (1863)

was probably the first to suggest that the dilatation of the stomach was due to an obstruction produced by pressure of the superior mesenteric vessels on the transverse portion of the duodenum. This view was endorsed and elaborated by the clinical observations and experiments of Kundrat (1891), Schnitzler (1895), Albrecht (1899), Byron Robinson (1893), Conner (1907), Doolin (1918) and others. As emphasized by Doolin, if the pathologist has this condition in mind at the necropsy, a dilated stomach and a duodenum partly or completely obstructed are the chief anatomical findings. It is assumed that the obstruction to the duodenum by the root of the mesentery can occur only when the intestines sink into the pelvis and thus exert a downward and backward traction on the mesentery. In support of this view are the cases of acute dilatation of the stomach occurring in patients with enteroptosis, emaciation from debilitating diseases such as diabetes, typhoid fever, and tuberculosis, and cases in which loops of ileum have become adherent in Douglas' cul de sac from localized peritonitis. This view also offers an attractive explanation for the frequency of acute dilatation in patients with spinal deformities, such as lordosis, where it is obvious that conditions should be optimum for mesenteric obstruction to the duodenum.

All of these studies and observations are of great importance in determining the pathogenesis of the entire symptom complex which attends acute dilatation of the stomach, but they have not clearly demonstrated that a primary occlusion of the transverse duodenum by the superior mesenteric vessels causes the dilatation, although this occlusion may be present and be of the greatest significance in the subsequent course of the disease. It can be easily demonstrated experimentally that a stenosis of the duodenum will result in a gradual dilatation and hypertrophy of the part above the obstruction and the stomach. An acute dilatation of the stomach, however, has never been reported following such a stenosis. As Novak (1921) has pointed out, in the relatively few cases of very high intestinal obstruction that have been reported as a result of various causes, dilatation of the stom-

ach has not been found. Furthermore, the occurrence of acute dilatation of the stomach during the course of an abdominal operation, and even with the patient in the Trendelenburg position, precludes the possibility of duodenal occlusion as playing any rôle in the production. As already stated it is far more probable that acute dilatation following surgical operations or manipulations involving extensive stimulation of either somatic or visceral sensory nerves is due to reflex inhibition of the stomach through the efferent fibers in the vagi and splanchnics and with a peripheral gastric motor mechanism depressed by anesthetics, debilitating diseases, or malnutrition.

However, a further analysis of the disease makes it appear quite improbable that the dilatation of the stomach is responsible directly for the protean symptoms that occur. The persistent vomiting, thirst, scanty urine, and collapse, which often make it difficult to distinguish the condition from peritonitis or acute intestinal obstruction, cannot be explained on the basis of reflex or mechanical effects from the stretched and dilated stomach. When such an acute dilatation has occurred on the operating table and has been relieved by the introduction of a stomach tube, the immediate reflex disturbances are slight and recovery is usually prompt.

One of the striking features of the disease is the enormous quantity of fluid that is regurgitated or may be aspirated from the dilated stomach. Indeed, Morris (1883) suggested that an excessive secretion from the stomach mucosa, a gastrorrhœa, was the cause of the gastric dilatation. In one of the early reports, Miller and Humby (1853) described a case of enormously dilated stomach which after death was found to contain "five basinfuls." All recent observers have commented on this excessive fluid. In most cases in which examination was made, the fluid contained little or no free hydrochloric acid, and practically always contained bile (Herrick 1906, Dragstedt and Dragstedt 1922). In the case to be reported here the fluid contained no free acid but the total chloride concentration was 0.35 per cent. It is undoubtedly made up of a mixture of the digestive secre-

work has greatly clarified our conceptions concerning the mechanism of this reflex inhibition of the alimentary tract. The experiments of Carlson and Luckhardt (1921) demonstrate that it is possible to obtain visceral reflexes from the stimulation of either somatic or visceral sensory nerves. While both motor and inhibitory fibers are present, the predominant effect of the vagus on the tonus of the mammalian cardiac and pyloric sphincters is inhibitory and on the stomach proper is motor. The opposite situation obtains in the effect of the sympathetic fibers from the celiac plexus. While both motor and inhibitory efferent fibers are likewise present, the predominant effect of the sympathetic fibers on the tonus of the cardiac and pyloric sphincters is motor and on the stomach is inhibitory. Relaxation of the stomach with contraction of the cardia and pylorus has been observed by one of us (L. R. D.) following direct stimulation of the peripheral splanchnic nerves in cats under light ether anesthesia or reflexly through stimulation of many of the abdominal viscera and of sensory fibers in the sciatic nerve. The nervous pathways involved in these visceral reflexes are indicated in the diagram in Figure 1. Relaxation of the stomach but to a lesser extent has been observed after section of the vagi. Most of the cases of acute dilatation have occurred following laparotomy, and of these operations on the gall bladder and female generative tract seem more prone than others to cause the trouble. Operations upon the stomach itself rarely give rise to an acute dilatation. The occurrence of acute dilatation following injuries and extra abdominal operations, such as those on the extremities and face, indicates that profound stimulation of somatic as well as visceral sensory nerves may bring about reflex inhibition of the stomach. The experimental evidence is thus quite adequate to show how the trauma incident to laparotomy or operative injury to any part of the body, or childbirth might occasion marked inhibition of the gastric tonus through reflex inhibition of the vagus and stimulation of sympathetic nerves to the stomach. However the degree of relaxation which is seen in some cases of acute dilatation in man cannot be readily produced in laboratory animals by any amount

of sensory stimulation. This may be referable to a species difference or it is possible that some depression in the peripheral gastric motor mechanism is necessary. There is, moreover, direct experimental evidence as well as clinical observation that chloroform or other anæsthesia depresses the gastric tonus (Payer, 1910), and this no doubt may be an important contributing factor in many cases. Most of the postoperative cases reported have followed general anesthesia.

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severed the attachment of the root of the mesentery to a large portion of the small intestine. The patient was immediately operated upon by Dr W T Harsba, of Chicago, who resected about 12 feet of the lower jejunum and upper ileum bringing the jejunum to the abdominal wall as a fistula. The patient thus had a functioning alimentary tract consisting of only the stomach, duodenum, and about 6 feet of jejunum. For the first 48 hours there was a profuse drainage of fluid from the jejunostomy opening. This suddenly ceased on the third day, and examination revealed a dilated stomach containing about 1,400 cubic centimeters of characteristic fluid. Aspiration of this fluid greatly relieved the patient, and shortly thereafter the drainage from the jejunostomy again became profuse. The accumulating fluid in the dilating stomach had evidently produced a secondary obstruction to the lower duodenum and prevented the escape of pancreatic and duodenal secretions into the jejunum. The withdrawal of the material in the stomach apparently relieved the duodenal obstruction promptly and permitted the escape of digestive secretions from the jejunostomy.

Halpert (1923) has pointed out that the obstruction is produced by a fold of mesentery belonging to the part of the small intestine which is displaced into the pelvis rather than by the vessels, and accordingly the term mesenteric obstruction to the duodenum is the more accurate. Irrespective of whether the occlusion to the duodenum be due to the direct pressure of the stomach with its large amount of fluid or to this mesenteric compression, it is obvious that the degree of obstruction cannot be very great. This is confirmed by postmortem observations, in which it is usually found that the obstruction can be easily overcome by the examiner's finger, a fact which has led many to question the importance of the duodenal obstruction in the pathogenesis. However, in the presence of the profound reflex inhibition of the motor function of the stomach, and possibly also of the duodenum, and the overdistention produced by gas and accumulating secretions, even a slight obstruction is of the greatest importance. The atonic stomach and duodenum are

then unable to propel their secretions into the lower intestine.

Under normal conditions, of course, the gastric and pancreatic juices poured into the upper part of the alimentary tract are more or less completely reabsorbed in the intestine lower down. Water and inorganic salts, the principal constituents of these secretions, are not appreciably absorbed in the stomach, duodenum, or even upper jejunum. A given quantity of water or salt solution placed in an isolated portion of the upper bowel may be recovered quantitatively several hours later. In the lower jejunum, ileum, and colon, however, the absorption of water and certain inorganic salts may be readily demonstrated by this method. It is clear then that for reabsorption, the gastric and pancreatic juices must be carried by the motor activities of the intestine into the ileum and colon. Interference with this transport must result in the loss of the various constituents of these secretions to the body either through vomiting or accumulation in the lumen of the nonabsorbing portions of the tract. The conception that harm might result from the failure of reabsorption of gastric and pancreatic juices has come about largely through experimental work on the pathogenesis of high intestinal obstruction. The loss of gastric juice has been offered as a very attractive explanation for the hypochloræmia, alkalosis, and dehydration that accompany obstruction at the pylorus (MacCallum and associates, 1920, Gamble and Ross, 1925, and others). A more or less crucial experiment demonstrating the fatal effect of the uncomplicated total loss of gastric juice in the experimental animal has been reported in some detail by the present authors (Dragstedt and Ellis, 1929 and 1930). In this work the continuous total loss of gastric secretion under conditions otherwise as nearly normal as possible and in which obstruction in any part of the alimentary tract was not present, was secured by the following operative procedure. Under ether anesthesia the vagus nerves in the dog were carefully separated from the lower end of the œsophagus below the diaphragm. The œsophagus was then sectioned at the cardia, and the cardiac end of the stomach infolded and closed. The

duodenum was cut across just distal to the pylorus and an end to end anastomosis was made between the esophagus and the duodenum. An external fistula was made of the pyloric end of the isolated stomach for the escape and collection of gastric juice. After such an operation (see Figs. 5 and 6) it is clear that all of the gastric secretion will be permanently drained away but there is present no element of obstruction. Food after being masticated and ensalivated passes directly from the esophagus into the upper end of the duodenum. It was soon found that, although the animals were given adequate food and water, they became rapidly weak and depressed, lost from one third to one half of their body weight, and died in from 5 to 8 days. Accompanying the symptoms were found characteristic changes in the chemistry of the blood. There was a profound fall in the concentration of chloride, an increase in the carbon dioxide combining power of the plasma, a shift in the hydrogen ion concentration toward the alkaline side and a late increase in non protein and urea nitrogen. The changes in the blood chemistry were roughly proportionate to the severity of the symptoms, and both were without question due to the removal or loss of gastric juice. The important elements lost in the gastric juice are contained in physiological salt solution since by the administration of adequate amounts intravenously the changes in the blood chemistry could be prevented and life indefinitely prolonged. The inefficacy of water alone indicates that it is the ions sodium and chlorine that are of supreme importance.

Of the remaining digestive juices—bile, duodenal secretion and pancreatic juice, the evidence is now clear that pancreatic juice at least must pass down into the absorbing region of the intestine and there be returned to the blood for life to continue. The innocuous effect of the total loss of duodenal juice was demonstrated by the author and associates several years ago (Dragstedt, Dragstedt, McClintock, and Chase, 1918). That the total escape of bile does not produce acute symptoms has been observed in the many cases of total biliary fistula in the clinic. While some of the earlier physiologists had observed cer-

tain deleterious symptoms following the production of an abdominal fistula of the major pancreatic duct of dogs, after the method of Pavlov, Elman and McCaughan (1927) were the first clearly to demonstrate that the continuous loss of the major portion of the pancreatic secretion uniformly caused death in a relatively short time. In a series of experiments, designed to determine this point and undertaken shortly before this paper of Elman and McCaughan appeared, the author and his associates (Dragstedt, Ellis, and Montgomery, 1929) secured data on the effect of the total loss of pancreatic juice by a new method which in large part substantiates and extends the conclusions of these investigators. The details of these experiments will be published elsewhere. It was early recognized that pancreatic fistula made after the Pavlov method by implantation of the major pancreatic duct of dogs into the abdominal wall, did not yield by any means the total secretion of the pancreas. In most cases only from 100 to 150 cubic centimeters of pancreatic secretion could be obtained in 24 hours. It seems probable that the suggestion of Elman and McCaughan that this is due to an ascending infection of the pancreas is probably correct, and it accounts for the failure of earlier observers to obtain a fatal result from experimental pancreatic fistula. In our experiments, the duodenum was cut across at the pylorus and again about 8 centimeters lower down, just below the entrance of the lower pancreatic duct. The pyloric antrum was resected and the lower duodenum anastomosed to the open end of the stomach by end to side suture. The common bile duct was sectioned near its entrance into the duodenum and implanted into the stomach. The upper section of duodenum containing the entrance of the pancreatic ducts was converted into a closed sac by inversion and closure of both ends. An external fistula of this duodenal pancreatic sac (Fig. 7) was then established by means of a gold plated cannula similar to that used in the stomach. Pancreatic juice was collected in rubber bags attached to the cannula. The animals recovered promptly from this rather extensive operation, but thereafter lost weight steadily and progressively and became gradually more

weak and depressed. Death occurred within 5 or 6 days. The blood chemistry exhibited changes in some respects opposite to that following the loss of the acid gastric juice. There was a decrease in the concentration of fixed base, to a less extent a decrease in chloride, a marked decrease in the carbon dioxide combining power of the plasma, and a shift in the hydrogen-ion concentration toward the acid side. The extreme loss in body weight was due almost entirely to a loss of water from the tissue spaces, the blood volume remaining normal even in the terminal stages. That death was due to the continuous removal of pancreatic juice is indicated by the fact that the administration of this juice by mouth prolongs life and corrects the altered blood chemistry. Again the fact that by the daily administration of from 2,000 to 3,000 cubic centimeters of physiological salt solution by intravenous injection, life may also be prolonged and the altered blood chemistry in part corrected, shows that it is the elements, sodium and chlorine, in pancreatic juice whose continued removal is fatal. It is thus very evident that the property of the gastric and pancreatic glands whereby they can remove these inorganic elements, sodium and chlorine, from the blood plasma until death is produced makes it necessary that their secretions pass into the absorbing portions of the intestine and there be returned to the blood.

The conclusion seems inescapable that it is this failure of reabsorption of gastric and pancreatic juice that is the major pathogenic factor in acute dilatation of the stomach. The clinical evidence has amply testified to the extreme atony of the stomach and often also of the upper duodenum. It is probable that in many cases this atony alone has led to the failure of reabsorption of the digestive juices since they were not propelled into the lower absorbing intestine. We can thus account for the lethal outcome of cases in which the pathologist has been unable to demonstrate any secondary occlusion to the duodenum. However, when this secondary occlusion is found to be present, even though it be of very slight extent, it may interpose a successful barrier to the feeble peristalsis in the proximal duodenum.

The occasional symptoms of tetany observed in patients with acute dilatation of the stomach may well be referable to the alteration in the chemistry of the blood due to this failure of reabsorption of the excreted digestive juices. An extensive alkalosis exists when there is a predominant loss of acid gastric juice. Tetany uniformly accompanies the severe alkalosis produced by forced breathing. We have been greatly surprised at not finding it in the dog in which an extreme alkalosis was produced by the withdrawal of fixed acid by the draining gastric fistula. It may be that the dog is less susceptible to tetany than man or that some other factor is operative. In this connection it should be observed that in the severe alkalosis produced by hyperpnœa and in which tetany occurs, there is also a profound reduction in carbon dioxide content and in carbon dioxide tension in the blood, whereas in the severe alkalosis following the loss of gastric juice the hydrogen-ion concentration of the plasma may be equally low, but the carbon dioxide content and carbon dioxide tension are far greater than normal. It is possible that a combination of hyperpnœa and loss of fixed acid may produce the alteration in blood chemistry necessary for tetany. This point is being further investigated.

The following case of acute postoperative dilatation of the stomach is significant in that the patient developed the same hypochloræmia and other changes in the blood chemistry which occur in the experimental animal following the simple uncomplicated loss of gastric and pancreatic juice.

The patient, a female of 70 years, was brought to the hospital with a strangulated femoral hernia which had been present for 48 hours. The history and physical findings are unimportant for the purpose of this paper, except for the examination of the blood chemistry. The chloride was reduced to 196 milligrams, the carbon dioxide capacity was 60 cubic centimeters, the urea nitrogen 14 milligrams and the non protein nitrogen 31 milligrams. There had been no vomiting. A blood transfusion (500 cubic centimeters citrated blood) was given and a section of gangrenous ileum imprisoned in the hernial sac, resected. Three thousand cubic centimeters of Ringer's solution was given by vein daily for the next 5 days, but the patient gradually became weaker and changes in the blood chemistry more marked. On the sixth day after operation the blood chloride had decreased to 180 milligrams, the carbon dioxide

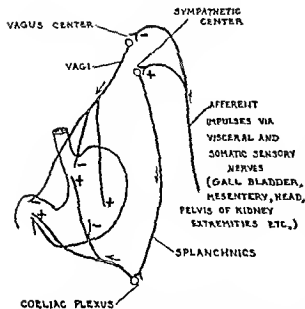


Fig. 1. Diagram illustrating the pathway of nervous impulses resulting in reflex gastric dilatation from the stimulation of visceral or somatic sensory nerves. There are of course intercalated neurones connecting the sensory and motor nerves here shown. Reflex stimulation of the sympathetic center is accompanied by a simultaneous inhibition of the antagonist or vagus center, an example of the so called reciprocal innervation.

capacity of the plasma had increased to 86 cubic centimeters while the non protein and urea nitrogen were 46 and 32 milligrams respectively. It was concluded at this time that the patient had a generalized peritonitis resulting from contamination at the time of resection of the gangrenous intestine. Vomiting of small amounts of fluid daily had been an inconspicuous feature but on the ninth day after operation 60 cubic centimeters of brownish fluid were regurgitated and saved for chemical analysis. It contained bile and blood, no free acid and a total chloride concentration of 0.35 per cent. Attempts to aspirate the stomach were given up because of auricular fibrillation and extreme exhaustion. The daily intravenous injection of Ringer's solution was continued, but in spite of this the blood chloride continued to decrease and on the tenth day reached 156 milligrams. Death occurred on the twelfth day after operation. At autopsy the striking finding was the greatly dilated stomach filling almost the entire abdominal cavity and extending into the pelvis. The illustration shows the relations before the abdominal viscera were disturbed. The dilated stomach contained about 3 liters of thin brown fluid. Unfortunately, this was lost but it is probable that its composition was similar to the vomitus secured on the ninth day. There was no evidence of peritonitis. A carcinoma of the neck of the gall bladder extending to and producing stenosis of the pylorus was found. The pyloric opening was approximately 2 mill

meters in diameter. The duodenum proximal to the point where the fold of mesentery and vessels passes anteriorly was slightly dilated and filled with brownish fluid similar to that in the stomach. No definite obstruction at this point was noted by the pathologist.

While there are several complicating factors in this case, the acute dilatation of the stomach here presents in its elements the same problems met with in other types. It seems probable that the sequence of events has been somewhat as follows. The stenosis of the pylorus was so gradual in development that the increasing motility and hypertrophy of the stomach succeeded in forcing the gastric content into the lower intestine. However, the development of the obstructed strangulated loop of ileum in the femoral hernia and perhaps of greater significance the operative trauma incident to the resection of the gangrenous intestine, resulted in such a profound reflex inhibition of the gastric motor mechanism that the feeble peristalsis could no longer force gastric juice through the narrow pylorus. It consequently accumulated in the dilating stomach. With the patient lying on her back in bed, it is quite probable that this weight of the filled stomach pressing upon the inferior horizontal portion of the duodenum produced some duodenal obstruction. Likewise, conditions were favorable for the development of a certain degree of secondary mesenteric obstruction to the duodenum inasmuch as the small intestines were forced into the pelvis by the dilated stomach and it is probable that the fold of mesentery belonging to the displaced intestine then exerted a definite compression although this was not evident at autopsy. The presence of fluid in the proximal duodenum similar to that in the stomach and its absence in the distal duodenum suggests such obstruction. Gastric juice and later pancreatic juice and bile accumulated in the non-absorbing upper duodenum and stomach and were thus effectually lost to the body. The development of the marked hypochloremia in this patient is added evidence that the failure of reabsorption of digestive juices here played a large rôle. Had this been the sole factor in this case, it is probable that the intravenous salt solution would have continued to keep the patient alive. However, the ad

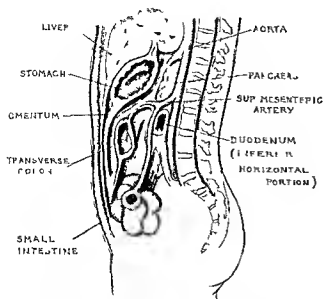


Fig 2 Diagram illustrating the normal relations of the stomach, the mesenteric vessels and fold, the inferior horizontal portion of the duodenum, and the spine

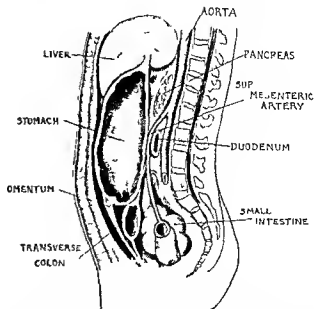


Fig 3 Diagram illustrating how dilatation of the stomach forces the small intestines into the pelvis, produces a downward and backward traction on the mesentery, and a secondary duodenal compression

vanced age, the myocardial damage, and the systemic intoxication from the carcinoma made such treatment ineffectual

SUMMARY

Evidence has been presented which offers a new interpretation of the cause of death in acute dilatation of the stomach. The dilatation is held to be due to reflex inhibition of the peripheral gastric motor mechanism through

efferent impulses reaching the stomach by way of the vagi and splanchnics. Experimental evidence is adequate to show that the stimulation of either visceral or somatic sensory nerves may produce such reflex gastric inhibition. The dilatation of the atonic stomach is produced by swallowed air and the accu-

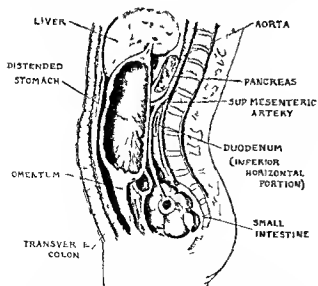


Fig 4 Diagram illustrating the greater liability of persons with lumbar lordosis to duodenal occlusion as a result of extreme gastric dilatation

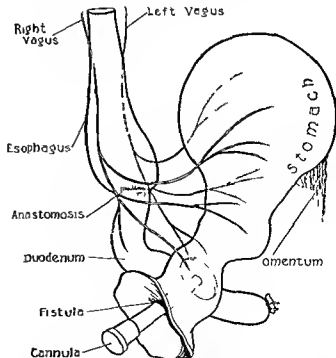


Fig 5 Diagram illustrating the fistula of the isolated entire stomach with innervation intact

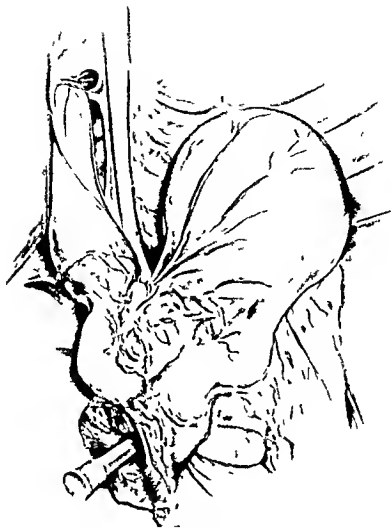


Fig. 6 Drawing made at autopsy showing the isolated stomach and fistula

mutating secretions of the stomach and duodenum. The fluid is made up of gastric and pancreatic juice, bile, and the secretions of the upper duodenal mucosa. From some recent observations on the normal volume of the digestive secretions in the dog, which indicate that previous estimates have been far too low, even the large amounts found in acute dilatation of the stomach do not seem excessive or the result of abnormal secretion. The cause of death is the failure of reabsorption of gastric and pancreatic juices, and more particularly of the inorganic elements, sodium and chlorine, excreted in these fluids. The failure of reabsorption in turn depends upon the in-

ability of the atonic stomach and duodenum to propel these secretions into the lower intestine where their absorption can take place. The gastric and duodenal mucosa does not absorb these digestive juices. In certain cases a secondary mesenteric obstruction to the inferior horizontal portion of the duodenum occurs and provides a further obstacle to the passage of the secretions into the lower bowel. In the clinical case reported the patient developed an hypochloræmia alkalosis, and dehydration exactly as occurs in the experimental animal when the gastric juice secreted is not allowed to be again absorbed. It is probable that the occasional symptoms

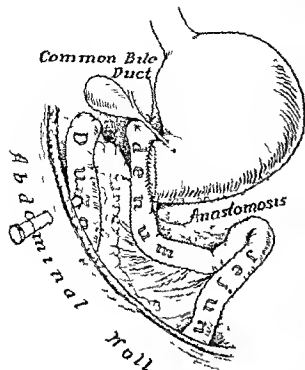


Fig 7 Diagram illustrating the fistula of the pancreaticoduodenal sac permitting the total escape of pancreatic juice

of tetany observed in cases of acute dilatation of the stomach are due to the alterations in the blood chemistry as a result of the failure of reabsorption of gastric juice

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Fig 8 Photograph taken at autopsy illustrating acute postoperative dilatation of the stomach

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THE SO CALLED FEMALE PROSTATE AND CONCRETION FORMATION IN THE FEMALE URETHRA

M J RENNER, M D, NEW YORK

From the Histo Pathological and Bacteriological Institute Dozent Dr Th Bauer Director

IN the gross anatomical examination of the female urethra, one finds only a few varieties of pathological conditions, for example, intensive passive congestion, fibrinous inflammation, varicosity, carunculæ, leucoplakia, cysts (Wesson), and diverticula (Peacock). Especially in the posterior portion of the female urethra of elderly women, one very occasionally finds a muscular thickening in the wall, with which are associated solitary or multiple thickenings of the mucous membrane. These are hard, black excrescences which look like nodules. They are designated as concretions. Very often during postmortem, one sees such changes in the prostatic portion of the male urethra, especially in the muscularis mucosæ folds at the side of the colliculus seminalis. In the male, these are doubtless prostatic concretions which are partly pressed out from the acinous portions of the excretory ducts by contractions, and seemingly some develop in the ends of the small ducts of the prostate. In the publications of Nagel, Waldeyer, Felix, Kaufmann, Aschoff, and others, the conception of a female prostate has found acceptance in theoretical medicine. According to the gross anatomical similarity between the previously mentioned conditions in the female and male urethra, it is necessary to draw a further comparison from a histological viewpoint and to examine, in this way, to learn whether or not any developmental remains of the prostate or Gaertner's ducts still exist in the female urethra.

At the suggestion of Dozent Dr Th Bauer, the director of the institute, I examined two urethras and bladders which were obtained from autopsies in 1926 and 1928 and which had been preserved in the museum. These were labelled with the diagnosis, "concretion formation in the muscularis mucosæ of a female urethra." I also obtained six other specimens of female urethras. The ages varied between 40 and 72 years. The urethras

had been preserved in 10 per cent formalin or formalin alcohol (some open and some closed) immediately after they had been removed from the cadaver. Examination was made of a series of specimens taken from the posterior portion of the urethra, cut in cross section and longitudinally.

In the description which follows, the two pathological specimens with concretion formation will be mentioned first.

CASE 1. Notes 815/26. Urethra and trigonum of a woman, aged 58 years. The urethra which is about 4 centimeters long, shows intensive injection of the muscularis mucosæ which is folded longitudinally. At its entrance into the bladder the urethra shows strange, shiny black, irregularly limited formations about the size of a pin point, almost sticking into the muscularis mucosæ. These are surrounded by a wall like thickening. The trigone shows the same formation but only in the immediate surroundings of the so called transitional fold (plicæ urethro vesicales) from the urethra to the bladder. These black concretions can be drawn up out of their muscularis mucosæ pockets with a needle. They are very hard and correspond absolutely to the concretions met with in the male bladder and sticking in the excretory ducts of the prostate. The remainder of the trigonal muscularis mucosæ and of the bladder, show no departure from normal.

Longitudinal sections from the bottom of the bladder to the external urethral orifice were taken for microscopic examination. Commencing with the examination of the trigonal portion, one finds a very wide muscular layer of longitudinal fibrils beneath the delicate transitional epithelium. Below this muscular layer, one sees complex gland structures of acinous and tubular elements which give the impression of prostatic glands. The epithelium shows a palely stained protoplasm and round oval seed like structures. The lumen is sometimes round and sometimes it is polymorphic, with excavations and puckering. The contents consist of a homogeneous mass, stained red with eosin. The glands increase in size and extent, the closer they approach the posterior portion of the urethra. Here one is able to follow the tubules ramifying without system in the crossing muscle bundles and passing deep into the muscle bed of the septum urethrovaginale. Both the superficial and deep portions of these complex gland structures have great resemblance to the male prostate and, in a certain way, to



Fig 1 Case 1 Glands found deep in vesicovaginal septum resembling Cowper's glands

Cowper's glands particularly in the peculiarity of the gland contents. In this case we find piled up amylaceous corpuscles in all degrees of development from their origin to the completed concretion. In all stages mineral deposits are seen in the preformed amylaceous corpuscles. Microscopically the product has a yellowish brown or sometimes a greenish polygonal form with points and sharp corners and by its increase in size outgrows the space of its developmental pouch and projects over the surface (Fig 1).

CASE 2 Notes 916/28 The urethra and trigonum of a woman aged 59 years. The urethra shows very small knots with superficial shallow depressions from which a black foreign body is projecting. This is especially noticeable in the posterior portion of the transitional fold of the bladder. Some of these foreign bodies by gradually growing out of their beds may be removed by slight pressure. These formations are absolutely limited to the posterior part of the urethra and the muscularis mucosae of the trigone is absolutely free. A small cyst about the size of a poppy seed should also be mentioned. It lies in the submucosa 0.5 centimeter from the bladder and can be seen only with difficulty.

With the microscope many glandular structures may be seen in the longitudinal section of the posterior urethra. Some are placed immediately below the epithelium of the muscularis mucosae and are called para urethral glands, others lie deeper in the smooth muscle of the urethrovaginal septum. The tubules ramifying deeper down have two rows

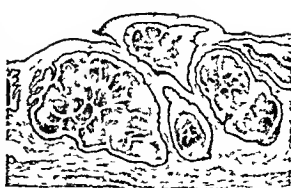


Fig. 2 Subepithelial prostatic ducts with many hard concretions

of epithelium with a palely staining protoplasm and round dark colored nuclei. The gland content is homogeneous staining red with eosin, and of a similar structure to the amylaceous corpuscles. In some of the glands it is chalky or encrusted with minerals. The natural color of these concretions is dark brown when seen macroscopically and greenish gray when seen microscopically. Corresponding to the colliculus seminalis of the male quite a big cyst covered with transitional epithelium is to be found in the posterior portion surrounded by a prostatic like structure of glands. In almost every such acinus the characteristic piled up formations similar to amylaceous corpuscles may be seen.

CASE 3 Notes 1382/30 Woman of 70 years. The bladder and urethra with small varicosities in the posterior portion were opened longitudinally and cut in cross section. Microscopically the extremely large blood filled cavernous space under the urethral muscularis mucosae can be seen to be partly thrombosed. Gland like structures apart from the small ones that have developed from Brun's nests and lie in the muscularis mucosae cannot be found in this case, nor can they be seen in the urethrovaginal septum. The whole urethra is infiltrated by round cells and presents a picture of senile atrophy.

CASE 4 Notes 1664/30 Urethra and bladder of a woman of 55 years were opened longitudinally. No macroscopic peculiarities were noted. In the posterior portion of the urethra microscopic tubules of the characteristic shape of the prostate and Cowper's glands and situated deeply in the musculature and passing deeply through the urethrovaginal septum similar to the cases described are present. In most cases the covering consists of one or two rows of epithelium. The content of these glands is a homogeneous mass stained red with eosin, which may be likened to pseudomucin.

CASE 5 Notes 2461/30 Urethra and bladder of a woman of 62 years. The specimen was preserved unopened with formalin and cut in parallel longitudinal series. The microscopical sections allow a clear view of the whole length of the urethra. If one concentrates at first on the portion of the external

urethral orifice, one can see Skene's glands ducts as tubules, most of them running parallel to the urethra, winding a little and crinkled, which by their direction and arrangement remind one of the para urethral ducts of the male urethra. The gland structure around the urethra contains too microcystic widened formations to be identified with prostatic elements by their arrangement and character. In most cases the formations are covered with a two row epithelium which is chiefly of the cubical or low cylindrical type. Moreover the content of these formations reminds one of the acini of the prostate because here are piled up forms consisting of a homogeneous mass, stained red with eosin, similar to the amylaceous corpuscles. Some of the microcysts also contain large quantities of the same brownish material, apparently originating by the confluence of small similar formations. Scattered in the mass itself, one finds chalk which may be considered as being the origin of prostatic concretions. In approaching the posterior part of the urethra, one recognizes branches of the prostatic gland or Cowper's glands reaching deeply into the urethrovaginal septum, apart from formations in larger quantities, previously described.

CASE 6 Notes 4563/30 Bladder and urethra of a woman of 48 years were removed intact and filled with formalin. After fixation, longitudinal cuts as far as the neck of the bladder were made throughout the whole length of the urethra. The epithelium at the base of the urethra shows histologically the same character as the transitional epithelium of the bladder, inclining in some places to the formation of papillae. In addition, one finds three types of glands in this portion: first those corresponding to the type of Brun's cell nests and which are accordingly developed from epithelial buds by central liquefaction, second, there are solitary glands or cysts covered with some rows of epithelium situated as a rule just below the urethral epithelium (peri urethral glands), and third, the more acinous in type, with numerous excavations and niches, the ramifications of which reach deeply into the urethrovaginal septum.

Contrary to those previously described, it seems that these acini are embedded in gaps of the twisting smooth muscle bundles, where they remind one very much of the male prostatic gland. The other types are almost circular and are surrounded by a ringed layer of smooth muscle.

CASE 7 Notes 4621/30 Urethra and bladder of a woman of 56 years, were opened and preserved. Series cut in cross section from the bladder neck to the external urethral orifice. Macroscopically, one can see a medium bulging originating in the base of the urethra. Microscopically, the portion belonging to the neck of the bladder and to the trigone respectively, is rich in Brun's cell nests and in small cysts which originate in the nests. By their close relation to the upper epithelial layer, they can hardly be confused with other formations. The posterior portion, which is adjacent to the bladder



Fig. 3 Specimen removed from Case 1

neck, shows a strange condition. Corresponding to the verumontanum, large cyst formations of the prostatic utriculus are to be found. The cystic cavity that is present here develops by the confluence of the two symmetrical cysts which look as though they had been previously covered, partly by several rows of cubical epithelium and partly by transitional epithelium. The contents consist of a fine threaded and a finely granular mass. Around this utriculus, prostatic glands and ducts are spreading, completely identical to the male colliculus. They are scattered about in the winding of the muscle bundles. Also in the middle portions of the urethra as well as in the anterior portions, formations similar to those described are to be found. A few gland ducts of the type of the prostatic and Cowper's glands respectively, are to be found in the urethrovaginal septum.

CASE 8 Notes 6650/30 Urethra and bladder from a woman of 49 years showed no anatomical peculiarities. The specimen was opened longitudinally and preserved. In the posterior urethral portion histologically large glandular structures are to be seen, which are arranged in an acinous collection. They penetrate deeply into the smooth muscle layer. The glands are mostly covered by a two row epithelium and solitary branches pass finally fairly deep down into the urethrovaginal septum. They present a picture of Cowper's glands and are comparatively poor in secretion.

In consideration of the findings, the first two cases are the most striking because genuine concretions are to be found in the posterior urethra. It can be proved absolutely that these formations have an autochthonous development and that they are not small stones which have passed down the upper

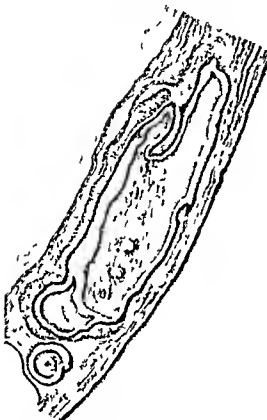


Fig. 4 Case 2 Subepithelial prostatic duct containing concretions

urethral ducts, because the concretions are sticking in the muscularis mucosae and can be removed only mechanically.

The question now arises whether the concretions originate in preformed glands, microcysts or cavities, or whether they are perhaps phleboliths of the corpus cavernosum. As the para urethral glands and ducts, which can be seen by the description already given, contain no concretions or their precursors, and as further reflection leads to the certainty that the small cysts originating in the Brun-Limbeck nests can never show concretion building, one comes to the natural conclusion that only the rudimentary prostatic portions can be considered as being the site of origin of the small stones.

Actually, the glands which have been found in the two cases correspond morphologically, and also according to their arrangement, to the male prostatic glands.



Fig. 5 Case 2 Specimen removed

In nearly all the female urethras which have been examined and described here, gland like formations were to be seen. These represent, on one hand, urethral ducts (*ductus para urethrales*) according to Skene, and on the other hand, as Felix, Nagel, and Waldeyer have already stated, formations of the type of prostatic glands. The findings mentioned, show that in the prostatic glands (so called) which have, up to now, not met with general approval, the presence of the smallest concretions, which are like coarsely ground pepper, could not be proved (Fig. 2). Another proof that the gland like formation in the urethra is of a prostatic nature is that the concretions may be traced by their deep penetration.

In most of the cases, it could be shown that the small gland complexes, which are sometimes quite close to the vaginal muscularis mucosae, are almost detached from the general gland structure of the urethrovaginal septum. According to their situation, they correspond to Cowper's glands and it is therefore more likely that a rudiment of Cowper's glands may be seen in this formation. If one looks upon this region from the standpoint of developmental history, one finds, in Corning, the definite statement that the *glandula bulbo urethrales* (Cowper) are only to be found in 48 millimeter long embryos, and that the prostate corresponds ontogenetically and phylogenetically to a complex of urethral

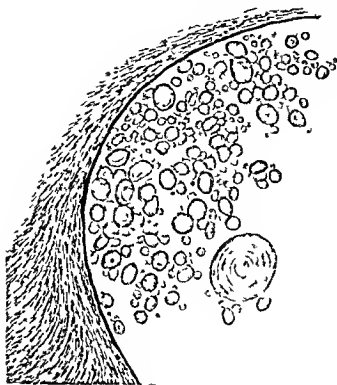


Fig 6 Amylaceous corpuscles in prostatic acinus Case 2

glands which break through the tunica muscularis. They completely surround the urethral prostatic portion by settling in the gaps of the interwinding muscle bundles. Corning expressly mentions that the urethral prostatic portion corresponds to a part of the female urethra and urogenital sinus. The openings of Wolff's and Mueller's ducts must be considered as the upper border of the urogenital sinus. This makes an area between these two points and the openings of the ureters into the bladder, which is not only the origin of the trigonum, but also provides the internal orifice of the urethra and the upper part of the urethral prostatic portion. In the male fetus, a primitive orifice of the urogenital sinus develops in the perineum, but this closes early. Therefore the female urogenital sinus, i. e., the vaginal vestibule, may be compared with the lower part of the urethral prostatic portion underneath the colliculus seminalis and the pars membranacea of the urethra of the male fetus, whereas the female urethra originates from (1) Mueller's prominence (colliculus seminalis of the male fetus), (2) the part bordered by the internal urethral orifice which corresponds in the male

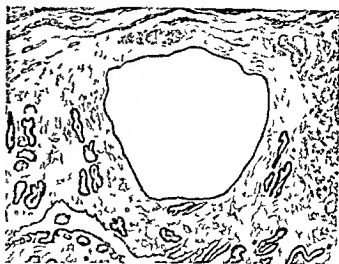


Fig 7 Cross section of female urethra. Cyst formation corresponding to the verumontanum surrounded by prostatic glands. Case 7

to the upper part of the urethral prostatic portion (Corning). According to Oudemans, the glandular bulbo-urethrales in marsupials occur throughout the whole length of the urogenital canal and in such thick layers that they make a fusiform swelling, which by an error has been taken for the prostate. It is only when glands also occur outside the smooth musculature of the urethra, that we can speak of the prostate in the correct sense of the word. According to Corning, there is, in human beings, a possibility that prostatic tissue develops in the course of the pars membranacea or cavernosa as a case described by Luschka proves. Here on the dorsum penis and the border of the pubic hair, prostate tissue could be found.

Further, it is not uninteresting to mention new experiments made by Lowsley, as a comparison of the cases described to the state of development of the male prostate.

In the third month, the first foundations occur on several parts of the urethral prostatic area. There are five existing groups, from which the one originating in the posterior urethral wall above the opening of the prostatic vesicle, furnishes the middle lobe, the two on both sides of the colliculus furnishing the two lateral lobes. One lobe develops behind the prostatic vesicle as the posterior section and finally a foundation on the anterior urethral wall develops into a rudimentary anterior lobe. As this complex of

questions is very important for the solution of the problem of prostatic hypertrophy, the subcervical glands (Albarran) should be specially mentioned. At the same time as the development of the urogenital sinus, the preprostatic elements, which can be identified as Skene's ducts and para urethral glands, whose openings into the vaginal vestibule lie on both sides of the external urethral orifice, developed from the posterior wall (Corning).

It can be stated, therefore, that in the fully developed female urethra, two kinds of glandular formations can be found, such as Sachs, in his various publications, has described. These are the peri urethral and para urethral glands. The material examined here definitely shows that the unilocular formations covered with several rows of cylindrical epithelium, can be considered as para urethral glands, whose origin from the Brun Limbeck cell nests is an established fact.

It can be seen immediately that the cysts found here are identical with those found in cystitis and pyelitis cystica, the phases of development which are very well known.

Whereas the prostatic elements show peri urethral arrangement they are acinous in character and covered with a two row low cylindrical celled epithelium. The microscopic examination of normal bulbo urethral glandulæ (Cowperi), which are in elderly men only poorly developed, shows a great similarity to the prostatic glands and the secretion product shows also much resemblance to the prostatic secretion. In the same way that the prostate is in rudimentary relationship with Skene's ducts, so the buds of the peri urethral glands can be proved to lie also as rudiments in the urethrovaginal septum. In a corresponding series of experiments, these glands may be demonstrated.

CONCLUSIONS

1 The female urethra shows much resemblance to the male urethra, especially in its relationship with accessory glands, genital apparatus, and Cowper's glandulæ bulbo urethrales.

2 The unilocular cysts and Skene's ducts are to be considered as para urethral glands.

3 Acinous formations are of prostatic origin, especially when they are embedded in the smooth musculature.

4 Corresponding to the colliculus seminalis, a submucous cyst is to be found in the female urethra surrounded by prostatic glands so that the prostatic utricle can be seen in rudimentary form.

5 The concretions which are eventually found in the prostatic glands correspond morphologically and in their consistency absolutely to the male prostatic concretions.

6 The physiological and pathological anatomical findings which have been mentioned are of an importance for the application of urology, which should not be underestimated as concretion formation in the urethral muscularis mucosæ may cause severe complications, such as ulcers, phlegmons, or strictures.

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NON-SPECIFIC PERITONEAL IMMUNIZATION¹

HERSCHEL B. MORTON, M.D. ROCHESTER, MINNESOTA

Fellow in Surgery, The Mayo Foundation

THIS work represents an experimental study on the production of peritoneal immunity in rabbits by the intraperitoneal injection of inert substances, and a study of the local cellular changes concurrent with such immunity.

Local peritoneal immunity can be induced in animals by repeated intraperitoneal injections of living bacteria, as shown by Goldblatt and Steinberg, and by injections of dead bacteria, as shown by Herrmann. Similar local immunity has been obtained by the use of such non-specific substances as physiologic solution of sodium chloride (14), nuclein (3), gum arabic (7), and various oils (15).

METHOD OF STUDY

The studies are the outgrowth of an attempt to produce rapidly peritoneal immunity after the methods of Besredka for producing cutaneous immunity. They are divided into methods of producing peritoneal immunity with non-specific substances, and observations on the associated cellular changes.

Studies on production of immunity. A strain of hemolytic streptococcus of moderate virulence was grown in dextrose broth for a period of 10 days. A sterile filtrate was obtained by using a Berkefeld (N) filter. Intraperitoneal injection of this filtrate into rabbits was followed in most instances by death within a few hours. Boiling the filtrate for 30 minutes removed or greatly reduced this toxicity. Animals were given intraperitoneal injections of 20 cubic centimeters of the heated filtrate on alternate days for four doses. Four days later these rabbits, with an equal number of control animals, were given intraperitoneal injections of a lethal dose of a 24 hour live culture of hemolytic streptococci. Within 2 to 8 days after the injection, all of the control animals died, whereas the inoculated animals remained alive and active.

Similar experiments were then performed, in which sterile dextrose broth and a 10 per

cent sterile solution of glucose were used as the immunizing substances. These substances proved equally effective in producing peritoneal immunity against hemolytic streptococci. Some of the immune rabbits in this group subsequently were inoculated intraperitoneally with a lethal dose of a 24 hour culture of colon bacilli. The control animals were all dead within 12 hours after this inoculation, whereas, in the prepared animals, evidence of ill effects was not seen.

In none of the animals was there evidence of formation of adhesions as a result of irritation from the injected solutions. This is in accord with the work of Cunningham (4), who showed that after 14 daily intraperitoneal injections of 10 per cent solution of glucose, desquamation of the peritoneal mesothelium is not sufficient to permit formation of adhesions.

Studies were next made to determine the minimal time required adequately to immunize rabbits against marked intraperitoneal infection. The immunizing substances were heated streptococcus filtrate, dextrose broth, 10 per cent glucose in physiological solution of sodium chloride, 5 per cent glucose in physiological solution of sodium chloride, and 1 per cent solution of sodium chloride. The animals used for the test may be divided into two main groups. Animals in one group were given intraperitoneal injections of the various solutions twice daily for 2 days, and those in the other group received three injections over a period of 24 hours. In both groups the test inoculation was given either 8 or 16 hours later. Normal control animals of corresponding size were inoculated simultaneously, using the same dosage from the same culture of hemolytic streptococci. The inoculation used as a test in this series of experiments was of sufficient dosage to kill all of the controls within 24 hours. However, this inoculation reduced the percentage of recoveries among the animals prepared over a period of 2 days.

¹Abridgment of thesis submitted to the faculty of the Graduate School of the University of Minnesota in partial fulfillment of the requirements for the degree of Master of Science in Surgery 1930.



Fig. 1. Phagocytosis of leucocytes and streptococci by macrophages in the peritoneal fluid from an immunized rabbit (Gram stain $\times 1000$)

to 80 per cent, and among those prepared over a period of 1 day to 54.5 per cent. In a few instances, definite immunity was present 30 hours after the initial immunizing injection, but in 80 per cent of the cases about 64 hours were required for a defense mechanism to develop, of sufficient strength to give protection. Increasing the period of immunization will increase the recoveries to 100 per cent, as shown in the previous experiments (Table I).

Study of cellular changes. Considerable study has been made of the cellular content in peritoneal exudates induced in animals by intraperitoneal injection of various irritants. Durham noted a leucopenic period in the first hour, which was followed by polymorphonuclear leucocytosis. The macrophages, with great phagocytic power, appeared after 15 hours. Von Mikulicz found general as well as local hyperleucocytosis. Buxton and Tracy found the number of macrophages markedly increased 24 hours after inoculation of prepared animals. Witts found the number of polymorphonuclear leucocytes in guinea pigs to reach a peak in 12 hours, and after 24 hours found them to be rapidly replaced by macrophages and lymphocytes. Metalnikov and Toumanoff found that the more guinea pigs are immunized or sensitized, the more

TABLE I.—SUMMARY OF RESULTS ON PERITONEAL IMMUNIZATION

| Immunizing substance | Immunization period (1 to 4 injections) days | Interval between last injection and test inoculation days | Rabbits | | |
|----------------------------------------------------------------|----------------------------------------------|-----------------------------------------------------------|----------|-----------|-----------|
| | | | Injected | Recovered | Died |
| Heated filtrate of culture of hemolytic streptococcus | 6 | 2 to 5 | 4 | 4 | |
| | 2 | 3 | 2 | 2 | |
| | 1 | 3 | 2 | | 2 |
| | | 3 | 4 | 3 | 3 |
| Dextrose broth (0.2 per cent) | 6 | 2 to 5 | 2 | 2 | |
| | 2 | 3 | 4 | 4 | |
| | 1 | 3 | 2 | 2 | |
| | | 3 | 4 | 3 | 1 |
| Glucose (20 per cent) in distilled water | 6 | 2 to 5 | 3 | 3 | |
| | 2 | 3 | | | |
| | 1 | 3 | | | |
| | | 3 | 1 | 1 | |
| Glucose (10 per cent) in sodium chloride solution (1 per cent) | 6 | 2 to 5 | 3 | 3 | |
| | 2 | 3 | 3 | 3 | |
| | 1 | 3 | 3 | 3 | 1 |
| | | 3 | 3 | 3 | 1 |
| Glucose (5 per cent) in sodium chloride solution (1 per cent) | 6 | 2 to 5 | 2 | 2 | |
| | 2 | 3 | 2 | | 1 |
| | 1 | 3 | | | |
| | | 3 | | | |
| Sodium chloride solution (1 per cent) | 6 | 2 to 5 | 2 | 1 | 1 |
| | 2 | 3 | 2 | 1 | 1 |
| | 1 | 3 | 2 | 2 | |
| | | 3 | 2 | 2 | |
| Total of test animals | | | 43 | 35 (81%) | 11 (26%) |
| Controls | | | 17 | | 17 (100%) |

rapid and intensive is the intraperitoneal reaction by the cells to defend the organism. Gay, Clark, and Linton found local pleural immunity against the streptococcus to be dependent on the presence of clasmatocytes in the pleural tissue and exudate. A large number of polymorphonuclear leucocytes alone would not confer immunity. Buxton and Torrey, however, reported on data which suggest that the macrophages cannot effectively dispose of *Escherichia coli* unless there is considerable polymorphonuclear response.

The observations on peritoneal smears are presented to show the relationship which seems to exist between the presence of certain cells, the so called macrophages, and local immunity against the hemolytic streptococcus. The term "macrophage" is to be used, as Witts uses it, to include cells which may be classified either as tissue clasmatocytes or monocytes of the blood.

Smears were made from the peritoneal fluid obtained at necropsy or by peritoneal punc-

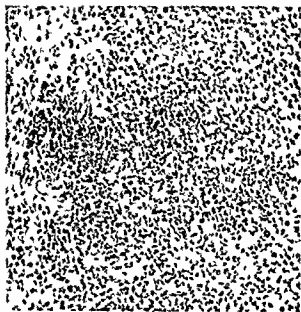


Fig. 2. Infiltration of the omentum of an immunized rabbit with macrophages (hematoxylin and eosin stain $\times 200$)

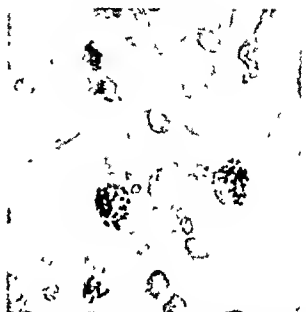


Fig. 3. Macrophages and phagocytosed streptococci within the omentum of an immunized rabbit (Gram stain, $\times 1000$)

ture. The smears were stained by Wright's and by Gram's method.

The results of this study (Table II) show that in those animals which survive the initial assault of the inoculation, there is moderate to marked cellular response in the peritoneal fluid. Phagocytosis, chiefly by the macrophage cells, is a prominent feature, there are few bacteria free in the exudate (Fig. 1). In contrast to this, the smears from animals that succumbed to the inoculation contained few cells, practically no evidence of phagocytosis, and a great number of free streptococci. There was a change in the proportion of the different types of cells in the smears according to the length of time they were taken after the initial preparatory injection and interval after the test inoculation. From the immune animals which were inoculated about 30 hours after the first immunizing injection, the smears taken 24 hours later disclosed a high percentage of polymorphonuclear leucocytes, whereas the smears from the animals which were inoculated 40 hours after the initial injection, with one exception, disclosed a preponderance of macrophages. In those animals killed 2 or more days after inoculation, the number of macrophages rapidly took the ascendancy. The number of cells in the smears reached a peak on the second to third day after inocula-

tion, in smears made on the fourth day the number of cells was greatly reduced and the majority held by the macrophage cells on the second and third days was being reduced by an increasing number of lymphocytes.

Goldschmidt and Schloss found increased bactericidal power of the omentum of animals after a second laparotomy. Portis reported experimental evidence to show that the omentum is a factor in production of antibodies following intraperitoneal injection of the antigen, and stated that the clasmatocytes appeared to be definitely involved in this production. Cunningham (5) stated that the majority of the cells in the peritoneal exudate during inflammation are derived from the clasmatocytes, which occur chiefly in the neighborhood of blood vessels and in the *taeniae latissimes* of the omentum. Hamazaki accredits the milk spots of the omentum with the supplying of histocytes to the abdominal cavity.

A comparative study showed a marked contrast both in the gross and the microscopic appearance of the omentums from protected and from non protected animals. The gross appearance of the omentums from the animals which had been adequately immunized was uniformly characteristic. The loosely folded omentum had a light, flesh color with mucoid

TABLE II—DATA ON PERITONIAL SMEARS AND SECTIONS FROM OMENTA

| Animal | Inoculation | Immunizing substances | Period of immunization, days | Interval between first injection and last inoculation, days | Result of test inoculation | Interval between test inoculation and taking of specimens, days | Cells in omentum | | Peritoneal smears | | | |
|--------|-------------|----------------------------|------------------------------|-------------------------------------------------------------|----------------------------|-----------------------------------------------------------------|---------------------|-------------|-------------------|------------------------------|----------------------|--------------|
| | | | | | | | Poly morphous cells | Macrophages | Cells | Poly morphous cells per cent | Macrophages per cent | Phagocytosis |
| 1 | 1 | 1 per cent sodium chloride | 1 | 3 $\frac{1}{2}$ | Recovery | 1 | Few | Moderate | Many | 40 | 60 | Marked |
| 2 | 3 | 10 per cent glucose | 1 | 3 $\frac{1}{2}$ | Death | 1 | Many | Few | Few | | | None |
| 3 | 3 | 10 per cent glucose | 1 | 3 $\frac{1}{2}$ | Recovery | 1 | Many | Many | Many | 8 | 92 | Complete |
| 4 | 1 | Streptococcus filtrate | 1 | 3 | Death | 1 | Many | Few | Few | | | None |
| 5 | 3 | Dextrose broth | 1 | 3 $\frac{1}{2}$ | Recovery | 1 | Few | Many | Moderate | 11 | 89 | Moderate |
| 6 | 3 | Dextrose broth | 1 | 3 $\frac{1}{2}$ | Recovery | 1 | Many | Moderate | Many | 84 | 16 | Moderate |
| 7 | 3 | 1 per cent sodium chloride | 1 | 3 $\frac{1}{2}$ | Recovery | 1 | Many | Many | Moderate | 84 | 16 | Marked |
| 8 | 3 | 1 per cent sodium chloride | 1 | 3 $\frac{1}{2}$ | Recovery | 4 | Few | Many | Few | 40 | 41 $\frac{1}{2}$ | |
| 9 | 3 | 10 per cent glucose | 1 | 3 $\frac{1}{2}$ | Recovery | 1 | Many | Many | Many | Unknown | Majority | Marked |
| 10 | 3 | 10 per cent glucose | 1 | 3 $\frac{1}{2}$ | Death | 3 | Few | Moderate | Few | 10 | 90 | Marked |
| 11 | 3 | Streptococcus filtrate | 1 | 3 | Death | 1 | Many | Few | Few | | | None |
| 12 | 3 | Dextrose broth | 1 | 3 $\frac{1}{2}$ | Recovery | 3 | Many | Many | Many | 55 | 62 | Marked |
| 13 | | Control | | | Death | 1 | Few | None | Few | | | None |

Death from hemolytic streptococcus pneumoniae pericarditis and purulent peritonitis
 Sixteen per cent lymphocytes

covering. By transmitted light, the unfolded omentum appeared as a thin white membrane with many small, branching blood vessels surrounded by a narrow zone of milk-colored tissue, the so called milk spots or *taches lacteuses*. Minute caseous particles were found in a few of the omenta that were immune but the appearance as a whole is strikingly different from that of the non-protected omenta which were either grayish or hemorrhagic, and in which there were areas of necrosis or of milary abscesses.

A microscopic study of these omenta stained by the hematoxylin and eosin or Gram method showed marked histological differences depending on the previous preparation of the animals from which they were taken (Table II).

Sections of omenta from immune rabbits showed moderate to heavy infiltration of macrophage cells with marked phagocytic activity, whereas the number of polymorphonuclear leucocytes contained in them might vary from many to few (Figs 2 and 3). In studying the sections of the omenta from

non immune animals, I was impressed by the small number of macrophages seen and the large number of polymorphonuclear leucocytes scattered throughout or massed together in many places, forming milary abscesses (Fig 4).

The study of omental sections from the animals in the groups prepared over the shorter periods of time is intensely interesting because here were found sections from prepared animals, some of which survived and some of which succumbed to the test inoculation. In the prepared animals which died, the omenta contained slightly heavier infiltration of macrophages than was noted in the control animals, but the actual number was still small. Practically all of the free cells of the omenta were polymorphonuclear leucocytes, which were often seen as masses of disintegrating cells. The difference between this picture and that seen in the sections from surviving animals is one of degree, and seems to be essentially an increase in the total number of macrophages present in the latter. It would seem that in the animals undergoing

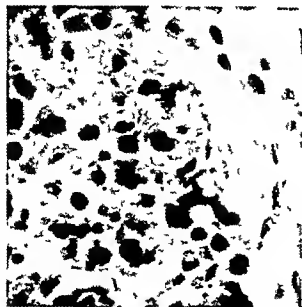


Fig 4 A mass of disintegrating polymorphonuclear leucocytes, with few macrophages, in the omentum of a rabbit that died from intraperitoneal inoculation (hematoxylin and eosin, $\times 1000$)

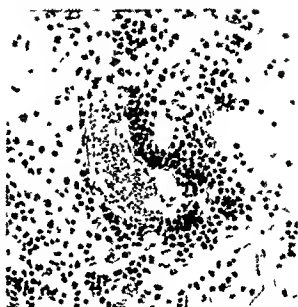


Fig 5 Distribution of macrophages in the omentum of an immunized rabbit 4 days after inoculation (hematoxylin and eosin, $\times 200$)

the short period of immunization a degree of reaction is found following inoculation, which is borderline between that which occurs in local immunity and that which occurs in the absence of such immunity.

In the sections of omenta taken from immune animals 1, 2, 3, and 4 days, respectively, after inoculation, a progressive increase in the number and percentage of macrophages was apparent. In those sections taken on the second day after inoculation the distribution of macrophages was uniform, and there was usually a preponderance of polymorphonuclear leucocytes (Fig 2). In sections taken on the third day after inoculation there was decrease in the number of polymorphonuclear leucocytes and an increase in the number of macrophages, which were more numerous adjacent to the blood vessels. In sections from animals killed on the fourth day after inoculation there was an extensive grouping of the small macrophages about the blood vessels and a less heavy infiltration of cells throughout the section (Fig 5). There was suggestive evidence in some sections that these small macrophages might be budding from the endothelium of the blood vessels, but no definite studies were made concerning them. The exact rôle which the macrophages play in the production of immunity is also ques-

tionable, but the evidence presented suggests that they are a significant factor in establishing local protection against the invasion of infection.

In this work, no attempt was made to compare the immunity produced by indifferent substances with that which follows intraperitoneal injection of specific bacterial antigens, because the immunity produced by the non-specific substances proved adequate to protect the animals against enormous amounts of intraperitoneal infection. The injection of relatively innocuous substances, such as weak solution of glucose or physiological solution of sodium chloride, seems preferable to the injection of foreign protein or bacteria which may often result in undesirable local and systemic reactions.

The pre-operative administration of solution of sodium chloride and solution of glucose in large amounts is often desirable. Clinical tests may prove that the peritoneal cavity is a valuable additional route for the administration of these substances. Given in this way, they should serve the double duty of supplying the patient with nutritious fluids and of producing peritoneal immunity. The production of peritoneal immunity, without producing untoward reactions, would seem to justify their use for such purposes only.

SUMMARY AND CONCLUSIONS

1 Local peritoneal immunity against the hemolytic streptococcus can be produced in rabbits by repeated intraperitoneal injection of various non specific substances

2 A test inoculation of sufficient dosage to kill 100 per cent of the control animals was given in all experiments

3 The percentage of recoveries among the test animals varied proportionately to the period of immunization. Immunity was adequately established in a large percentage of the animals about 60 hours after the initial injection, and immunity was proved in 100 per cent after several days

4 An histological study of peritoneal fluid and omental tissue indicates that this immunity is dependent on or is associated with, the presence of macrophages

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CLINICAL SURGERY

FROM THE MARIAHILFER AMBULATORIUM AND HOSPITAL IN VIENNA¹

THE SURGICAL TREATMENT OF DUODENAL ULCER

PROFESSOR HANS FINSTERER, VIENNA, AND DR. FELIX CUNHA, SAN FRANCISCO, CALIFORNIA

UNDER the heading of surgical treatment of duodenal ulcer there are various procedures available such as gastro-enterostomy, partial resection of duodenum and stomach, and for that penetrating ulcer which cannot be resected there is resection of the stomach for exclusion of the ulcer. We have chosen as a subject "The Surgical Treatment of Duodenal Ulcer" featuring principally the "resection for exclusion" because the immediate and permanent results are so favorable that the method is entitled to wider adoption.

Gastro-enterostomy has given little satisfaction and very unsatisfactory permanent results in the hands of many surgeons. Von Haberer, as an illustration, gives only 37 per cent of his cases as remaining symptom free over a continued period of time. In the remaining percentage of his cases the ulcer persisted, did not heal, or there arose the added complication of a gastrojejunal ulcer. Schloffer gives 50 per cent of his cases in the same category.

With the material in the clinic here, gastro-enterostomy in gastric or duodenal ulcer has not been performed in 10 years except in a rare case of non-complicated duodenal ulcer in an aged patient if the referring physician was absolutely against a resection.

In a study of the last 619 cases of ulcer the frequency of gastro-enterostomy is found to be about as follows: resections for duodenal ulcer, 516; resections for gastric ulcer, 90; gastro-enterostomy for duodenal ulcer, 13—showing a percentage of 2.1 per cent gastro-enterostomies.

During this series there were performed an additional 12 gastro-enterostomies in the following types of cases: acute perforation of a duodenal ulcer and acute hæmorrhage in a non-resectable ulcer. In spite of operation death occurred in 7 of these cases of gastro-enterostomy: 2 from absolute stenosis of the pylorus followed by inanition, 1 from embolism of the pulmonary artery secondary to a femoral thrombosis.

Of the remaining cases of gastro-enterostomy only 5 cases are strictly symptom free, 4 are improved only to the extent that they are symptom free as long as they restrict their diet. The remainder are unhealed, 3 being subject to repeated hæmorrhages and all have developed a gastrojejunal ulcer. Three of these latter have been reoperated upon and the ulcer has been demonstrated.

It appears worthy to note that the more recent literature from England and America indicates fewer favorable permanent results than was formerly reported. Conspicuous examples are Pannet, of London, reporting 31 per cent unfavorable results, Lewishohn, of New York, reporting 50 per cent failures and 24 per cent of these developing a gastrojejunal ulcer, while Karl Meyer, of Chicago, observed that as high as 35 per cent of patients develop a gastrojejunal ulcer following gastro-enterostomy.

The resection of the duodenal ulcer itself which was formerly thought to be much more dangerous than the resection of a gastric ulcer has found increasing popularity, so that today in Austria and also in Germany it has come to be the method of choice. This has been more or less since the publication of the works of Clairmont and von Haberer in 1917, advocating it.

If an ulcer of the anterior wall penetrates into the pancreas so that the excavated pancreas forms the floor of the ulcer then, in order to avoid an opening into the duodenum and an infection resulting from it, the excision of the ulcer base from the pancreas, as in a malignant tumor, is not only extremely difficult from a technical standpoint but is also dangerous, because any lesion of the pancreas may very easily lead to an acute necrosis of the pancreas. This is as was formerly advocated by Clairmont and von Haberer and other surgeons.

As an illustration, Clairmont reported 5 deaths from necrosis of the pancreas in his first 100 cases of resection of the duodenum. We have never removed the ulcer base or floor in a penetrating

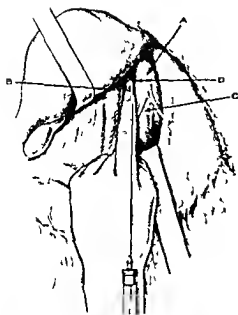


Fig 1 Drawing showing the aorta B vena cava C hepatic artery D site of injection over eleventh or twelfth dorsal vertebra

ulcer but rather have separated the ulcer border away from the liver or pancreas leaving the base and then closing the hole in the duodenum or stomach temporarily by suture and proceeding with the resection. Contamination of the field of operation by the acid stomach contents can be prevented by shutting off the stomach from the pylorus with a wide clamp. The use of the suction apparatus directly in the area while the dissection is going on will also absorb what little stomach contents may come into the field.

A small amount of stomach contents leaking into the field while the ulcer is being resected is not alarming as we do not believe the gastric contents to be highly infectious, as we have seen cases of perforation in which the entire abdomen was filled with the acid stomach contents at the time of operation, but which healed without any evidence of infection, and in which only a mechanical cleansing of the abdomen had been done. These patients had been operated upon within 12 hours of perforation, however, and bacterial changes had probably not yet had time to take place.

In the clinic material here, there has not been one death from peritonitis following resection of an ulcer by the method mentioned. The few instances of death from peritonitis have been in cases of ulcer of the anterior wall and have been due to infection from without.

In cases in which the ulcer penetrates the pancreas and extends far outward, that is to say as far as the ampulla of Vater, and it is impossible to isolate the common bile duct from the callus infiltration of the ulcer, then the resection of the ulcer is not only extremely difficult technically but is also dangerous to life because of the impossibility of making a satisfactory and safe closure of the duodenum. The suture usually gives way, and peritonitis ensues with fatal termination or the development of a duodenal fistula. In a case in which the ulcer has invaded the common bile duct the latter may be eroded and have an opening in the ulcer base so that a spontaneous choledochoduodenostomy has been made. If during the operation this lateral opening is overlooked in the resection of the ulcer there will occur either a diffused biliary peritonitis or at least the development of a biliary fistula which may later require a second operation. When the erosion of the choledochus is noted during the resection then, as a lateral suture of the bile duct is impossible without incurring a stenosis it becomes necessary to ligate the common duct completely and implant the central stump into the descending portion of the duodenum or after ligation of the duct to perform an anastomosis between the gall bladder and the duodenum. In those cases in which the common duct cannot be isolated from the callus infiltration of the ulcer, we are unable to determine whether the duct is eroded laterally or not. Therefore the ulcer is left *in situ* and the 'resection for exclusion' is performed.

The 'resection for exclusion' which Professor Finsterer has practiced for 14 years and which he described in 1918 in *Zentralblatt fuer Chirurgie* consists in the following. The antrum is severed two fingerbreadths centrally from the pylorus, the distal part is closed by suture in two layers, and is then covered by the gastroduodenal omentum. Then two thirds of the proximal part of the stomach is resected. Complete severance of the antrum excludes the ulcer from the acid stomach contents provided retrograde filling of the duodenum has been prevented by a correctly made anastomosis. In this manner even the largest penetrating ulcer will completely heal in a short time. In one such case the patient died 7 weeks after the first operation from an acute gangrene of the gall bladder and multiple liver abscesses. The autopsy showed that the ulcer base was completely healed. Removal of the antrum, which represents the motor of the secretory apparatus, and removal of the mucous membrane of the pars media of the stomach, wherein the hydrochloric acid is se-

creted, permanently removes the hyperacidity, and in this way the recurrence of a gastrojejunal ulcer, which is the usual cause of a relapse after a resection for excision, is avoided.

The technical operative procedure in a case of clinically diagnosed duodenal ulcer is about as follows. One hour before operation the patient is given 0.2 grams pantopon, just prior to coming to operation 0.15 to 0.2 grams morphine is given with 0.005 grams atropine. The amount of morphine may sometimes be lessened, dependent on the state of health of the patient, or for other reasons. It is used mainly to overcome any nervousness or apprehension on the part of the patient.

An exact block anaesthesia of the abdominal wall is made so that an absolutely painless opening of the abdomen in the midline is possible. The abdomen is opened with a midline incision, ensiform to umbilicus. In order to make the anaesthesia more complete a one-half per cent solution of novocain-adrenalin is injected into the peritoneum of the abdominal wall from within, as far as possible away from the midline. Local injection of the splanchnic plexus is then made by means of a long needle which is inserted between the vena cava and the aorta above the level of the hepatic artery and which lies on the body of the eleventh or twelfth dorsal vertebra. Seventy cubic centimeters of a one-half per cent solution of novocain-adrenalin is injected here.

When the anaesthesia is completed the stomach and duodenum are examined from without. A chronic ulcer of the anterior wall is easily demonstrated either by the radiating lines of scar tissue or by the formation of pseudodiverticula lying either on the side of the lesser or greater curvature. In addition, large callus infiltration of the hepatoduodenal ligament is often found. The ulcer on the posterior wall, however, is not easily demonstrated especially if flat. It is not visible externally, and if it lies far outward and penetrates into the pancreas it is particularly difficult to demonstrate and is very easily overlooked when it is actually present.

In order to overcome this difficulty, it has been the custom to do a gastrotomy, i.e., make a small incision in the antrum, then with the right index finger (without a rubber glove) enter and palpate the stomach wall from within and, through the pylorus, palpate the duodenal wall as far as the papilla. This procedure has repeatedly demonstrated ulcers in the descending part of the duodenum near the papilla, particularly small

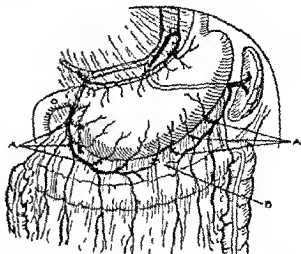


Fig. 2. Drawing showing A ligation of right and left gastroepiploic arteries, B middle of stomach arcade missing.

posterior ulcers penetrating into the pancreas which, from the external findings alone, would have been completely overlooked.

In an ulcer penetrating the pancreas, the question is then to decide whether the ulcer can be resected without too great danger to the patient. The adhesions between the descending part of the duodenum and the gall bladder, which are usually present, are separated, then the peritoneum of the posterior abdominal wall is incised at its junction with the lateral wall of the duodenum, and the duodenum is thus sufficiently mobilized to determine whether or not the ulcer on the posterior wall involves the papilla. Then the margin of the hepatoduodenal ligament is incised, the common bile duct is exposed, and its course with relation to the posterior duodenal wall and the ulcer outlined and examined. If it is then determined that the ulcer does not involve the papilla and that the common bile duct can be isolated from the callus ulcer infiltration, then resection of the ulcer can be performed without undue danger to the patient.

The resection itself begins with the detachment of the gastrosplenic ligament from the stomach. Each individual vessel running from the left and right gastroepiploic arteries to the stomach is ligated close to the stomach, the arteries themselves remaining intact. No division is ever made by mass ligation below the arch. When ligation of the vessels of the gastrosplenic omentum is made below the arch the omentum becomes dusky and necrotic, because the anastomoses passing to the transverse colon and to the middle colic artery do not furnish a blood supply sufficiently rich for the omentum, especially one which is rich in fat. On

¹ For complete technique see Finsterer, Local Anesthetics Methods and Results in Abdominal Surgery. Translation by J. Burke.

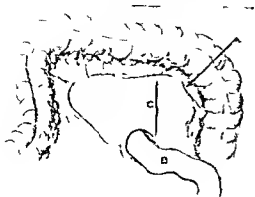


Fig. 3 1 Left colic artery B jejunal loop C, slit in transverse mesocolon

the right side this separation of the gastrocolic ligament extends as far as the duodenum, on the left side a hand's breadth above the middle of the greater curvature. We recognize the middle of the greater curvature as that part in which the arcade of vessels is missing and in which the small arteries run toward the stomach and toward each other.

The next step is the separation, in like manner, of the hepatoduodenal ligament and the lesser omentum from the stomach. Before the duodenum is detached from the pancreas, and if it has been determined to do a Hofmeister Finsterer modification of the Billroth II operation, the first jejunal loop is looked for and fixed with guide suture. A slit is made in the transverse mesocolon close to the left colic artery from the base toward the arch, and through this slit is passed the jejunal loop and the stay suture is clamped for later identification. The left and right borders of the slit are likewise marked with guide sutures. The transverse colon, with the greater omentum, is then returned to the abdominal cavity and covered with a sterile compress.

The duodenum is then detached from the pancreas, a relatively easy procedure when the ulcer is on the anterior wall. In those cases of penetrating ulcer the posterior wall of the duodenum is separated from the pancreas and the callus base. This is done best by knife resection keeping as close as possible to the duodenal wall in order not to injure the pancreas itself. This procedure produces a round hole with hard margins in the posterior wall of the duodenum corresponding to the base of the ulcer which has been left behind. This is at once closed by several sutures made diagonally to the longitudinal axis of the duodenum.

The deep excavated floor of the ulcer in the pancreas is mechanically cleansed with sublimate solution or sponged with alcohol. The cautery is never used to cauterize the base, as experience has shown that in the casting off of the eschar a large pancreatic vessel touched by the cautery and not sufficiently closed by thrombus may begin to bleed and cause no little trouble.

Only when the distal margin of the ulcer is sharply separated from the pancreas is normal duodenal wall visible, so that it is necessary to separate the pancreas from the duodenal wall until at least 1 centimeter of normal duodenum is provided. While doing this, special attention must be paid to the accessory pancreatic duct, which must not be injured in the dissection nor caught in a ligature because in some cases this duct may constitute the chief excretory duct of the pancreas. After the pancreas has been separated from the duodenum, a crushing clamp is applied to the duodenum 1 centimeter proximal to its lowest dissected edge and the clamp is then removed and the duodenum ligated in the furrow made by the crushing. One centimeter distal to this ligature, a pursestring suture is applied which remains temporarily untied. In order to keep a grasp on the duodenum, two stay sutures are applied 2 to 3 centimeters distally, one on the superior wall and the other on the inferior wall. One centimeter proximal to the ligature of the duodenum a clamp is applied and, between this clamp and the ligature the duodenum is divided by means of the cautery. The proximal part is covered with sterile gauze and turned up out of the way. The distal part is held by means of the two stay sutures by the second assistant while the first assistant invaginates the stump into the duodenum and the pursestring suture is closed and tied by the surgeon. Over the pursestring suture two or three Lembert stitches are made, bringing always peritoneum to peritoneum and invaginating the posterior wall, which is free, of peritoneum. A suture is then made which takes in the edge of the hepatoduodenal ligament and the hepatocolic ligament and the duodenal stump in such manner that when it is closed or drawn together and tied the duodenal stump becomes buried under, i.e., becomes retroperitoneal and covered over.

The resection then proceeds to the stomach and the left gastric artery must be ligated where it approaches the stomach after being given off the celiac trunk. A point is made of doubly ligating here in order to prevent any later mishap by a possible slipping of the ligature, as a secondary hemorrhage from so large a vessel in such close proximity to the aorta would be fatal before any

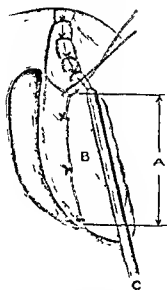


Fig 4

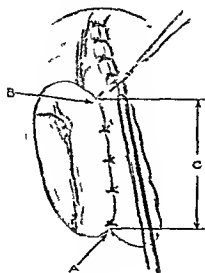


Fig 5

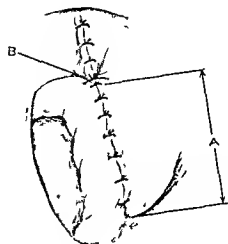


Fig 6

Fig 4 Drawing showing *A*, left border of mesocolon slit, *B*, posterior wall of stomach, *C*, clamp on lower 10 centimeters of resected stomach edge to be used in anastomosis

Fig 5 1 First layer of Lembert sutures *B*, approximate point of first stitch, *C* width of anastomosis

Fig 6 4, Anastomosis completed, *B*, first three angled suture

surgeon could stop the bleeding by any reoperation. A Payr stomach clamp is then applied obliquely to the axis of the stomach from the lesser curvature near the cardia to the greater curvature near the gastrosplenic ligament. In this manner the line of separation of the stomach lies in the line of the direct continuation of the esophagus. Just below the Payr clamp and proximally, the stomach is closed by a through-and-through continuous suture from the lesser curvature to as far as a point 10 centimeters from the greater curvature.

Three 10 centimeter clamps are applied distally to the Payr clamp completely closing off the stomach. The separation of the stomach is made by dividing with the scalpel between these clamps and the Payr clamps leaving a slightly larger margin of tissue toward the greater curvature. The resection is thus completed and there remains the anastomosis to be made.

A curved Doyen clamp is applied to the unclosed lower portion of stomach proximal to the Payr clamp but several centimeters away. Grasping the excess border of the lower part of the stomach edge with a tooth forceps, the Payr clamp is removed by the first assistant. At the same time the lower part of the stomach, which was not sutured, is caught temporarily by the surgeon with a broad 10 centimeter clamp. The Doyen clamp is now removed and the upper part of the stomach, which has previously been sutured through and through, is covered by two rows of

interrupted sutures inverting the corner by means of a U suture.

Care should be taken here that the proximal part of the stomach especially that between the Doyen clamp and the clamp on the stomach edge is empty, otherwise the mucous membrane is pressed against the seromuscularis from within and, in the fixation of the mesocolon slit to the posterior stomach wall or in making the first row of Lembert sutures, it is possible for it to be caught in the suture. This would be dangerous as peritonitis would inevitably follow. With this in mind the left border of the mesocolon slit is fixed to the posterior wall of the stomach by means of three or four interrupted sutures. The anastomosis is then made between the resected border of stomach and the first jejunal loop by means of three layers of sutures (Fig 4). The anastomosis is about 10 centimeters in width.

It is especially important at this point that the jejunal loop should lie in correct apposition to the posterior wall of the stomach, the afferent portion, which is fixed to the ligament of Treitz, must lie on the lesser curvature, and the efferent portion, which is mobile, on the greater curvature. The loop should not be taken too short nor too close to Treitz' ligament in order to avoid any kinking which may occur when the stomach stump is small or lies high up under the diaphragm or when the plica duodenojejunalis lies very deep. The loop also must not be made too long or the afferent portion may sag and favor retrograde

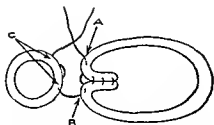


Fig 7. Cross section of stomach and jejunum illustrating three angle suture. A, Anterior stomach wall, B, posterior stomach wall, C, twice grasping jejunum.

filling. The approximate distance on the jejunal loop from the plica duodenojejunalis in which to make the first stitch is generally from 3 to 6 centimeters away, depending on the position of the plica, the size of the stomach stump, and the degree of ptosis of the stump.

The first row of Lembert sutures is made interrupted, silk being used. The seromuscular layer is made with a continuous running suture of chromic catgut and when this layer is completed the clamp closing the opening into the stomach is removed and the Doyen clamp above it is released slightly in order that bleeding vessels in the mucous membrane may be caught and ligated. If at this time any stomach contents escape the suction apparatus is used to aspirate it. With no clamp applied to the jejunal loop, the jejunum is opened and any bleeding vessels in the mucous membrane are caught with hemostats and ligated. Any bile present is also removed with the aspirator or, if only slight, is simply swabbed out.

The mucous membrane layer of stomach and jejunum is then sutured with a continuous chromic catgut suture which is locked in each stitch in order to prevent hemorrhage. The seromuscular layer of the anterior wall is closed by a continuous chromic catgut suture in the upper portion while in the lower part interrupted sutures are used in order to prevent any tendency to stenosis which if any is at this point.

In order to overcome the insecurity of the three angle corner where the stomach closure suture meets the anterior and posterior suture of the anastomosis a special suture is made which grasps first the anterior wall of the stomach, then the posterior wall, then grasps twice the jejunal loop and draws this together in such manner that when tied the jejunum lies broad against this three angled corner and completely covers it. By making an additional one or two of these sutures above the first, the afferent loop is fixed higher on the stomach. In this manner retrograde filling of the duodenum is overcome—a very important

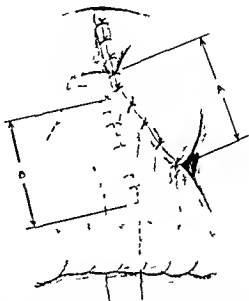


Fig 8. A, Right border of mesocolon slit sutured to anterior stomach wall. B, line of anastomosis completely covered with mesocolon.

factor, as any retrograde filling following operation can cause the closure suture of the duodenal stump to give way because of the increased pressure. In those cases of "resection for exclusion" where the pylorus is left intact retrograde filling will prevent the healing of the ulcer and thus the operation will fail to help the patient.

When the anastomosis is completed, the right side of the mesocolon slit is drawn over the anastomosis and fixed to the anterior stomach wall with 4 to 6 interrupted sutures, so that the operative field above the mesocolon is completely shut off from the free abdominal cavity—a particularly important step when the ulcer base has been left *in situ* or if there has been any escaped stomach contents in the field (Fig 8).

The anastomosis itself, which during the operation was in the upper abdominal region, lies now in the free abdominal cavity. It is important that the mesocolon slit should not be fixed to the anastomosis suture but at least two fingerbreadths above it and fixed to the stomach wall, otherwise an obstruction of the anastomosis by pressure or contraction will take place (Fig 9).

In order to prevent any ptosis of the transverse colon or any adhesion of it to the anterior abdominal wall, the gastrocolic ligament is caught below the gastro epiploic arteries and by means of two or three interrupted sutures is fixed to the

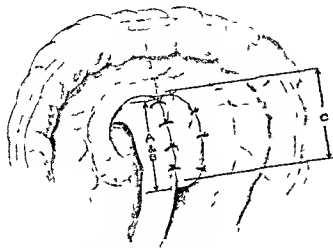


Fig 9 A, Anastomosis lying below mesocolon in free abdominal cavity, B, line of anastomosis, C, left border of mesocolon slit sutured to posterior stomach wall

peritoneal covering of the pancreas and to the base of the mesocolon

As a rule, the abdomen is closed tightly in three layers. However, in a case of a penetrating ulcer in which the base has been left behind, a rubber drainage tube is inserted, which from the fourth day on is shortened a bit each day and is entirely removed in a week, provided there is no marked pancreatic secretion present, which occurs only very rarely. If in old patients there is oozing or accumulation of blood or a bleeding vessel cannot be located, a drainage tube is inserted for 24 hours so that the blood is evacuated outward.

If the duodenal ulcer, due to its location and extension, cannot be resected, the "resection for exclusion" is performed. In this operation the gastroduodenal ligament is detached from the stomach for only two fingerbreadths proximal to the pylorus and the lesser omentum the same. At this point, the antrum is severed from the pylorus between two clamps. The proximal part is covered with sterile gauze and turned out of the way while the distal part, held by the clamp, is first closed with a through-and-through suture and then covered over by Lembert sutures. This stump is covered with the remainder of the gastroduodenal ligament and the small omentum. The lesser omentum is then ligated toward the cardia and the left gastric artery is ligated in the typical place as before described. The stomach is divided in the usual place as in a typical resection and an end-to-side anastomosis made with the first jejunal loop. In a case in which there is well marked hypertrophy of the musculature the line of separation of the antrum must be farther away from the pylorus (three fingerbreadths) in order to make the Lembert sutures without any stretch



Fig 10 Resected antrum including pylorus

ing or tension. In these cases the mucous membrane from the eliminated portion of the antrum is removed as far as the pylorus and there closed by a suture. The seromuscularis is cut on the side of the greater and lesser curvature making thus an anterior and a posterior flap which is overlapped and fastened by suture over the mucous membrane suture in order to make a safe and sure closure.

If the ulcer is located in the descendent portion of the duodenum and near the papilla, the pylorus also is removed in addition to the antrum, the duodenum being severed close to the pylorus. The wound is closed by a through-and-through suture, and is then covered by Lembert stitches. The suture line is then covered with the gastroduodenal ligament and the hepatoduodenal ligament. The left gastric artery is ligated in the usual place and the typical stomach resection is made, and an end-to-side anastomosis of stomach to first jejunal loop. In these cases the abdomen is always drained (Fig 10).

The anastomosis practiced by us has a distinct advantage over the anastomosis of the whole width of the stomach as described by Polya and Reichel, in that retrograde filling of the afferent loop and of the duodenum is avoided. This is because the afferent loop is fastened upward and at a higher level than the efferent loop when the sutures are made at the three angled corner so that the anastomosis is in the direct line of the oesophagus and so that, when the patient is in the standing position, the loop does not become turned or fallen (Figs 11 to 14).

If one makes an anastomosis with the whole breadth of stomach as in the Polya-Reichel method, especially in cases in which only the antrum is resected, the stomach, which before was fastened to two fixed points (oesophagus and duodenum), is now freely movable on the right side and when the patient sits or stands can become turned to such a degree that there occurs a

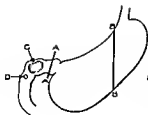


Fig 11

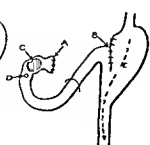


Fig 12



Fig 13

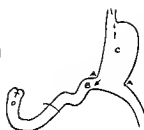


Fig 14

Fig. 11 Finsterer resection antrum removed A line of resection at pylorus B line of resection of stomach C ulcer D papilla

Fig. 12 Finsterer resection patient standing A Suture of pylorus covered with Lembert stitches B obliteration of three angled corner and fixing of afferent loop at a higher level by means of same stitches thus overcoming retrograde filling C, ulcer D papilla E, arrow which shows

direct continuity of esophagus stomach and jejunum

Fig. 13 Pólya Reichek resection A, Anastomosis entire breadth of stomach

Fig. 14 Pólya Reichek resection patient standing A Anastomosis entire breadth of stomach B, showing afferent loop at same level as efferent making retrograde filling easily possible C arrow shows possible direction of food current

stretching of the small curvature This causes the afferent loop to assume the same level as the efferent and the food moving forward along the lesser curvature will reach the afferent loop instead of the efferent In order to overcome this defect in the operation, Reichel suggested that an entero-anastomosis be made between the ascending part of the duodenum and the efferent jejunal loop This, however, favors the occurrence of a gastrojejunal ulcer in the jejunal loop lying above the entero-anastomosis Due also to the danger of a gastrojejunal ulcer an anti colic anastomosis in which an entero anastomosis is always necessary, is never performed here

In the cases of "resection for exclusion" with excision of the mucous membrane the abdomen is always drained because of the possibility of an insufficiency in the suture line closing the antrum, in which case the duodenal contents must have an outlet through the abdominal wall otherwise the life of the patient is in danger Drainage is also always used in those cases of "resection for exclusion" with removal of the pylorus in which the suture line closing the duodenum is made in inflamed tissue which is very unreliable a slight tearing away allowing enough leakage to cause a diffused peritonitis if there is no drain, whereas with drainage the worst that may occur is a duodenal fistula which will heal spontaneously (Figs 15 and 16)

The Billroth I type of operation, which, since its recommendation by von Haberer, is used by many leading German surgeons (Friedemann) in cases of duodenal ulcer, seems dangerous because when a sufficient separation of the duodenum from the pancreas is made the posterior wall of

the duodenum is free of peritoneum This with the extensive resection of the stomach, which is necessary to prevent a recurrence of the ulcer, causes too great tension in the bringing together of the duodenum and stomach and the cutting through of the sutures is not uncommon The possibility of peritonitis from an insufficient suture line is always present For this reason the Billroth I method is rarely used here in this clinic in cases of duodenal ulcer, e g, there were 24 cases in the last 10 years

In cases in which there is a long mobile descending part of duodenum with a ptosis of the stomach, we make use of the modification of the Billroth I operation as described by von Haberer This modification consists in anastomosing the stump of the stomach to the lateral wall of the duodenum, an end to side anastomosis or terminolateral gastroduodenostomy (Figs 17 and 18)

In our material the upper part of the stomach is closed and the anastomosis is made with the lower half (von Haberer uses the entire breadth of stomach) because, in using the whole breadth of stomach lumen, the contracting sutures produce a series of folds in the stomach which may favor the occurrence of a relapse

The terminolateral gastroduodenostomy is superior to the Billroth I method in that the stenosis, which occurs fairly often after this latter method and requires re operation, does not occur Second, less of the stomach need be resected than in the original Billroth I method, because if the gastric contents still contain any efficient free hydrochloric acid after the operation it enters the duodenum at a point below the papilla of Vater

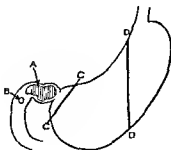


Fig 15

Fig 15 Finsterer resection (antrum left *in situ*) 4 Ulcer, B, papilla, C, line of resection leaving antrum and pylorus, D, typical line for resection of stomach

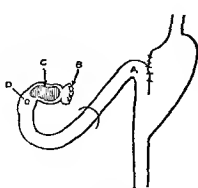


Fig 16

Fig 16 4, Showing typical anastomosis and position of the afferent loop, B, pylorus left *in situ* C, ulcer, D, papilla

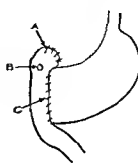


Fig 17

A, Duodenal stump, B, papilla, C, line of anastomosis using full breadth of stomach

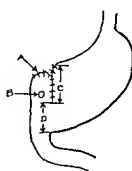


Fig 18

Fig 18 Billroth I modification used by Finsterer A, Duodenal stump, B, papilla, C, upper portion of stomach closed by suture, D, lower portion anastomosed with duodenum

not above it as in the Billroth I method, and therefore it is at once neutralized by the alkaline bile and pancreatic juice. The terminolateral gastroduodenostomy is especially favored in young people who live in the eastern countries under poor hygienic conditions and who are more or less liable to infections such as typhus, dysentery, and cholera.

The von Haberer modification shares also with the original Billroth I method the danger of insufficiency of the suture line when the sutures are made under undue tension and there is insufficient power of regeneration in the tissues. Also there is the danger of a stenosis occurring by a kinking of the duodenum at the point where the descending and ascending portion join. In the resection for exclusion the terminolateral gastroduodenostomy is used when the descendent part of the duodenum is long and easily mobilized, but in cases of ulcer extending to the papilla this is only rarely possible. In our own material there were only 6 cases. The only advantages over the usual end to side anastomosis with the first jejunal loop is that the amount of stomach which it is necessary to dissect in order to obtain the same permanent end-result is much less.

AFTER-TREATMENT

In all cases of resection in order to obtain the best results from the operation, the after-treatment is equally important as the exact performance of the operation, especially in old people with chronic bronchitis, emphysema, etc.

For the first 24 hours after the operation the patient receives only a Murphy drip of either salt solution or 5 per cent glucose. In the next 24 hours, a tablespoonful of an alkaline mineral water or of cold tea is given by mouth every half

hour. If there has been no vomiting after 48 hours the patient is given tea with milk in larger quantities so that after the fourth day a diet of milk, milk gruel, mashed potato, and tea with milk is allowed. This is increased according to the need of the patient until a point is reached in about 2 weeks when finely minced meat is added to the diet.

In cases of postoperative hæmatemesis, the stomach can be washed out with the stomach tube, iced water being used even on the first day, with no danger to the suture line. This usually takes care of the bleeding, but if not a second washing is done and followed by using about 100 cubic centimeters of a 1:1000 solution of nitrate of silver which can be repeated once. Intravenous calcium and subcutaneous injection of horse serum is also sometimes used.

A re-laparotomy for arrest of hæmorrhage is quite difficult and usually of little value as a hæmorrhage from a small vessel in the mucous membrane can hardly be detected. In our material there is only one death from post-operative bleeding. That occurred 36 hours after operation in a case of penetrating ulcer of the duodenum in a patient who also had a severe alcoholic cirrhosis of the liver. It is probable that a blood transfusion might have saved this case but it was not available at the time this patient was operated upon.

The severe degrees of atony of the stomach or intestine such as are not infrequent in operations done under narcosis are entirely absent when local anesthesia is used. Gas is freely discharged from the bowel in from 24 to 48 hours after operation. In those patients who have been subject to severe chronic constipation or in those who have acquired a morphine or opium habit and

therefore must have large doses of narcotic after operation, meteorism sometimes occurs and is combated by using dry hot air, washing out of the intestine with warm water (temperature must be 40 degrees C to be effective), and pituitrin given 2 or 3 times daily.

If there exists a peritonitis due to an infection introduced from without, unfortunately we have found any treatment powerless, even enterostomy which is so effective in those cases of post-operative narcotic atony. It has been tried repeatedly but without success.

It is important that aged patients, poorer class laborers and similar types, all of whom suffer more or less from chronic bronchitis, should be taught to breathe deeply and regularly after operations and especially to cough while at the same time a nurse supports and helps them by making pressure with her hands against the recti muscles, in this way preventing any tension on the freshly sutured wound.

As the effort of coughing is thus free from pain, less morphine is required, which is favorable to the patient. Although morphine lessens pain, at the same time it does away with the irritative cough which is productive therefore morphine favors stasis and is harmful. Expectoration is also encouraged by the regular application of warm camphorated oil to the chest. In the last year we have been using transpulmin, a quinine derivative, as a prophylactic against pneumonia and have given this twice daily. Patients over 60 years of age must be gotten out of bed on the second or third day after operation and allowed to sit in a chair for short periods. In the following out of this postoperative scheme of treatment we have found that many complications are avoided. In our material there have been but 3 deaths from pneumonia in the last 1,312 cases of resection for ulcer. It is curious to note that elderly people seem to give most favorable results, as in a series of 60 cases of resection of duodenal ulcer in patients all over 60 years of age and ranging from 60 to 77 years in age there were no postoperative complications and no deaths.

END RESULTS AND MORTALITY

Fortunately, deaths from pulmonary embolism have been rare in this clinic, only 2 cases occurring after resection for duodenal ulcer. The possible explanation for this may be in the use of local anesthesia which does not harm the patient's heart in any way or in the fact that all patients are put to bed after operation in a slight Trendelenburg position with the trunk elevated in order to avoid congestion in the lungs and the trunk.

The field of operation can hardly be the starting point of an embolus as the efferent veins all open into the portal vein and emboli would tend to be carried to the liver and retained there. In the 2 cases occurring here one was in a woman 49 years of age with large varicose veins. She had been up 4 days when the embolism occurred on the tenth day after operation. The other gave the usual embolism history—a young man 28 years of age apparently in the best of health, on getting out of bed on the tenth day fell over and died immediately.

The mortality after duodenal resection was comparatively high during the war (Professor Finsterer 49 cases with 4 deaths, a mortality of 8 1 per cent). This mortality was due to lack of proper equipment, improper selection of cases due to the exigencies of the occasion and also probably due to inexperience. Since the war the mortality has been steadily reduced as shown in the following figures. There have been 566 cases of resection of the duodenum with 18 deaths, a percentage of 3 1 per cent. That the mortality in the Billroth II modification operation is less than in the Billroth I operation can be seen by the fact that 429 of these cases were the Hofmeister Finsterer modification of the Billroth II operation with 10 deaths or a mortality of 2 3 per cent while 137 cases were either the Billroth I operation or the von Haberer modification with a mortality of 8 cases or 5 8 per cent.

In the modification of the Billroth II operation as practiced by us, if the suture is carefully made in three layers, any insufficiency of the anastomosis suture is avoided because the jejunal loop is movable, therefore, in any contraction of the stomach there cannot occur any tension in the suture line. On the contrary, in the original Billroth I method and in the von Haberer modification, if the suture line is under tension and the regenerative power of the peritoneum is insufficient, there will occur on the third to fifth days a cutting through of the suture and a dehiscence of the anterior wall. Thus a peritonitis occurs because the stomach shortened by the resection is stretched between two immovable and fixed points, i.e. the cardia above and the duodenum below. With every contraction of the stomach, therefore, there is a pull on the anastomosis suture. In our experience when the typical anastomosis described was used not only in duodenal ulcer but also in gastric and recurrent gastro-jejunal ulcer, there has not been one death due to an insufficiency of the suture line.

In 137 cases of duodenal ulcer in which either the original Billroth I operation or the von

Haberer modification was done there were 2 deaths from peritonitis due directly to an insufficiency of the suture line. Also in 116 cases of gastric ulcer and in 36 cases of gastrojejunal ulcer in which the same type of operation was used, there were 4 deaths due to an insufficiency of the suture line.

In the resection for exclusion in which the pylorus was left *in situ* there were 92 cases with 2 deaths or a mortality of 2.1 per cent. In 34 cases in which the pylorus was resected, the mortality rose to 14.7 per cent. Three deaths were due to peritonitis secondary to the giving way of the suture closing the duodenal stump. In the last 6 years, however, in the cases in which the pylorus had been resected, there had not been a death due to peritonitis because in every case drainage had been used so that if the suture line gave way, which occurred in 4 cases, there occurred instead of a general peritonitis a duodenal fistula which later healed spontaneously.

After every resection for a duodenal ulcer we insist on the most careful postoperative dietary management because in all of these cases there exists a chronic gastritis which must be given time to heal. Tissue specimens will practically always show marked chronic inflammatory change.

In estimating the permanent end results of operation, it is fair to count only cases in which 3 years have passed since operation, therefore, only cases operated upon prior to December 31, 1926, are used for statistical data. Cases lost track of or whose subsequent history after operation is unknown should not be included in the total number of cases as among these unknown cases there may be a high percentage of failures. Our experience has been that the number of cases which could not be traced for various reasons, loss of address, etc., is 6.7 per cent of the total, and it is fair to assume that among these untraced cases there may be many who do not answer our questionnaire because they are not cured and possibly have been reoperated upon elsewhere. We feel that all statistics which include 10 per cent or more of untraced cases in their total are valueless.

In 307 cases of resection for exclusion with the typical end-to-side anastomosis, 293 cases are healed after a period varying from 3 to 14 years after operation. By "healed" is meant that the patients are able to eat any food without discomfort, have gained in weight (several patients as high as 60 pounds), and that they have been able to follow their occupation. Four cases are considered as improved but not healed because there are certain foods which they must avoid or they

complain of heartburn or gastric distress. These have no pain in the region of the stomach but are suffering from an old tuberculosis which was present before operation. Ten cases are classified as unhealed, that is they have not been able to resume their former occupations, and they still complained of pain and gastric distress after operation. Among these there are 4 cases in which the symptoms present were not due to a recurrent ulcer but were caused by a chronic colitis, which existed prior to operation. In 4 other cases the clinical symptoms suggested the presence of a gastrojejunal ulcer but it was not possible to prove this. In one of these cases in which a later reoperation (choledochoduodenostomy) was required a gastrojejunal ulcer was not found. In 2 cases a recurrent gastrojejunal ulcer was proved at a second operation to be the cause of the symptoms.

The first of these was a patient who had had a resection of half of a dilated stomach for duodenal ulcer in 1917, with no relief of symptoms. Six years later he was operated upon for a gastrojejunal ulcer, and at this time it was possible to remove quite a large portion of the stomach, illustrating that the first resection had not been extensive enough. This case following the second operation is now well.

The second case of gastrojejunal ulcer had been operated upon several years ago in another clinic and a gastroenterostomy had been done. The duodenal ulcer had not healed so that a second operation was performed in this clinic. The duodenum, pylorus, and the antrum were resected as far as the anastomosis. The symptoms recurred some time after this operation and a third operation, performed in this clinic, revealed a gastrojejunal ulcer at the site of the old anastomosis. This was resected and the typical radical operation for gastrojejunal ulcer was performed. This patient died of a peritonitis subsequent to a secondary infection.

In 71 cases in which were used either the Billroth I method or the von Haberer modification, the permanent results were much less favorable. Six cases were classified as failures, or 8.5 per cent. In 2 of these cases, there was a recurrence of the ulcer which required a second operation. One case was a probable recurrence but was not reoperated upon and another case required a gastroenterostomy to relieve a stenosis of the first anastomosis. Following this gastroenterostomy the patient was well.

The statistics quoting the permanent end-results in the resection for exclusion must be divided into two groups. The first group includes those in which the pylorus with a small portion of the antrum was left *in situ*. In 71 cases in which this was done and which had been operated upon in the period of from 3 to 14 years ago, 63 cases are free from complaint, the body weight has increased (in some cases as high as 70 pounds), and

the operative result is satisfactory. Two cases are improved in that they are able to work and are symptom free, if they avoid certain foods which experience has taught them will cause heartburn. A third patient had complained of vague symptoms of distress after eating which entirely disappeared when the appendix was removed 6 years ago, since which time he has been symptom free. In these 3 cases only the antrum with the distal one third of the stomach was removed. The patients are free from pain and are themselves satisfied with the operative result, so that if one were to include these 3 cases as healed the total excellent permanent results are equal to 90 per cent.

Five cases developed a gastrojejunal ulcer which required a second operation. In 3 of these done early in the series only the antrum had been resected at the first operation. In 2 of these cases in which a two thirds resection had been done a gastrojejunal ulcer developed because the patient did not follow directions to have the gall bladder, which formed a large tumor mass with the penetrating ulcer, removed at a second operation. These 2 cases developed a gastrojejunal ulcer in spite of an extensive resection.

The second group of cases of resection for exclusion in which the pylorus was resected consists of 18 cases. Twelve cases have been symptom free over a period of from 3 to 14 years. Three cases are improved and 3 cases were considered unimproved. In 2 of these unimproved cases a previous gastro enterostomy had been done for duodenal ulcer without relief of symptoms, and in the second operation for resection the ulcer was found to extend so far out toward the papilla that it had to be left *in situ* and only the pylorus and antrum as far as the previous anastomosis were resected.

Thus it can be seen that in the resection for exclusion where the pylorus was left *in situ* there were 90 per cent that were symptom free, while in the operation with simultaneous resection of the pylorus only 66 per cent of the cases were symptom free, showing that the permanent end result is not dependent on the resection of the pylorus, as so many surgeons have stated. Therefore, removal of the pylorus is justifiable only in those cases in which it is without great danger to the patient.

Favorable end results can be attained only when a large portion of the stomach is resected and also when retrograde filling of the duodenum is avoided. This is easily possible in the method of resection as practiced by us. This is even more important in the resection for exclusion in those cases in which on account of the extensive hypertrophy of the musculature a slightly larger portion

of the antrum must be left behind to insure a reliable closure. In such cases a retrograde filling of the duodenum would excite an increased secretion of gastric juice and thus cause a relapse of the ulcer.

In those cases of penetrating ulcer in which a larger portion of antrum is necessarily left *in situ*, a secondary operation can be done 6 weeks later and the excluded part of antrum, pylorus, and ulcer site easily removed, as the ulcer is completely healed. This makes in reality a two stage resection of a duodenal ulcer but is much to be preferred to the two stage method practiced by Delore in which first a gastro enterostomy is done and then in a second operation a resection of the duodenal ulcer is made. In using this method of Delore, one would be obliged to make the gastro enterostomy high up on the fundus so that it would not hinder an extensive resection at the second operation and experience shows that gastro enterostomies made high up in the fundus lead to severe functional disturbances. In our material a two stage resection is done only in a case in which there occurs later an appendicitis or some gall bladder pathology, and the patient is operated upon for this then at the same time a resection of the excluded antrum is done. From the standpoint of the patient, two less severe operations are much better than a forced resection of an inoperable duodenal ulcer with its attendant high mortality or to a simple gastro enterostomy, with its poor permanent result. To those adherents of the neurogenic theory, who see in the leaving of the pylorus *in situ*, the etiology of a recurrence the pylorus may thus be removed in a second operation thus gratifying their theory.

The resection for exclusion gives the same good permanent end results as the actual resection of the duodenal ulcer itself, provided a sufficiently large amount of stomach is removed. Certainly it is an indirect method but it is not a palliative method as it has been called in some of the literature. It is just as radical as the resection of the ulcer itself.

We are of the opinion that in duodenal ulcer the primary seat of the affection is not in the duodenum itself but in the stomach, chiefly in the antrum, which only macroscopically is normal in appearance but upon histological examination exhibits chronic inflammatory changes which are the cause of the abnormal gastric juice secretion as has been shown by Stoerk, Konjetzny, and others. Therefore, if a patient with a duodenal ulcer is to remain permanently cured, the pathological changes in the stomach must be removed and this can be done with assurance only by

radical resection This view was advanced by Okunczyk before the French Congress of Surgery in 1928

The permanent end-results obtained in resection for exclusion so far surpass those obtained by gastro enterostomy (advocated by von Haerer for those cases in which the ulcer cannot be resected) that this should be the method of choice

We are also of the opinion that in duodenal ulcer the permanent end-results of resection depend entirely upon the extensiveness of the resection of the stomach and upon the permanent removal of the cause of the pathological secretion of gastric juice and not upon any special predisposition on the part of the patient against which a surgeon would be powerless Therefore, a recurring ulcer after resection means that the resection was not sufficiently extensive and that the patient can still be cured by a more extensive resection

As an argument against the size of the stomach resection having any significance, mention has been made in the literature of the cases of relapse even after extensive resection It must be borne in mind that there exists a wide divergence of opinion as to what really constitutes an extensive resection Many surgeons consider a resection extensive if in a case of duodenal ulcer they resect merely the antrum as suggested by Schur and Plaschkes in their monograph We understand an extensive resection to be one in which at least two-thirds of the stomach is removed It must not be forgotten also that in a case in which there is an enormously dilated stomach the dilatation consists almost entirely of antrum so that in a resection of two thirds of a considerably dilated stomach not only the normal cardinal third is left but also the entire pars media, and sometimes even a part of the antrum remains *in situ* This certainly is not a resection of two thirds of the stomach and does explain the reason for recurrence of the ulcer

As an illustration we report a case from the clinic here

A man suffering with a duodenal ulcer had had a Billroth I operation and two thirds of the stomach had been resected, according to the history sheet from the clinic in which the operation had been done Soon after the operation the patient's symptoms recurred At the second operation here in this clinic a large duodenal ulcer penetrating into the pancreas was found The ulcer extended as far as the anastomosis and in addition a large portion of stomach was adherent to the lower surface of the liver It was possible in this case to resect more than 10 centimeters on the lesser curvature before we reached the typical point in the vicinity of the cardia at which our resection is done Following this operation the patient remained free from symptoms

In this case the first operation consisted probably of a resection of two-thirds of a greatly

dilated stomach but a large part of the lesser curvature was untouched as evidenced by the fact that at the second operation it was possible to resect so much That there was a possibility that postoperative dilatation of the stomach could account for this amount of lesser curvature or for an increase in the extent of the stomach does not seem probable, especially as in this case, the stomach had become fixed to the liver making a fixed point and unless the liver enlarged at the same time as the stomach it does not sound reasonable

The importance of the size of the resection of the stomach is also evidenced by the fact that in cases in which repeated relapses followed less extensive resections, permanent healing was obtained after a sufficiently extensive resection

As an illustration, in 126 radical resections for recurrent gastrojejunal ulcer, we found cases in which 4 operations had been done by various methods in other clinics and only after the fifth operation, an extensive radical resection, was the patient cured

A vivid example of this was in the cases of two brothers

Posterior gastro enterostomy had been done for duodenal ulcer Soon after operation there was a recurrence of pain and repeated hemorrhages In 1919, in one of the brothers a radical operation for gastrojejunal ulcer was done here and at this time it was found that the old duodenal ulcer had not healed and that a new ulcer had developed on the anastomosis loop Resection of the duodenum, the ulcer, of the pylorus and nearly half of the stomach, which was considerably dilated plus a resection of the anastomosis loop was done Then a Y anastomosis was made, stomach stump to jejunum (Figs 19 and 20)

This operation brought no relief of symptoms, and the patient complained of constant pain, heartburn, and frequent hemorrhages Medical treatment, X ray treatment, etc., were of no avail and the opinion of the internists handling the case was against any further surgery on the basis that this patient was probably predisposed to ulcer formation and that another ulcer operation would lead only to the formation of another ulcer Finally the pain became so unbearable that it could not be controlled even with large amounts of morphine (as much as half a gram daily) and therefore a third operation was done in September, 1921 The brother had the same operative and clinical experience and also came to a third operation In both cases a comparatively large stomach stump was found plus a large ulcer of the anastomosis loop deeply penetrating into the pancreas and into the mesentery of the jejunal loop The ulcer reached exactly as far as the site of anastomosis of the afferent jejunal loop Resection of the ulcer was done leaving the ulcer base *in situ* Extensive resection of the stomach stump was done so that only a narrow rest of the fundus remained corresponding to about one fifth of the normal stomach On account of the shortness of the jejunal loop another Y anastomosis was made Both patients were symptom free after the operation, with no pain no heartburn and an increase of body weight of from 30 to 40 pounds Both are able to work and carry on their occupation without any attention being paid to diet This

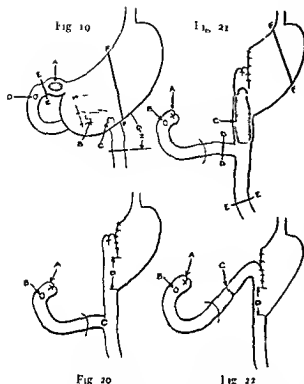


Fig 20

Fig 22

Fig 19 1 Duodenal ulcer B gastroenterostomy stoma C recurrent gastro jejunal ulcer D papilla F line of resection of duodenum E line of resection of stomach G H resection of anastomosis loop

Fig 20 1 Duodenal stump B papilla C end-to-side anastomosis of jejunum D typical end-to-side anastomosis lower half of stomach to jejunum

Fig 21 A Duodenal stump B papilla C recurrent gastro jejunal ulcer D line of resection of upper jejunal loop E line of resection of lower jejunal loop F line of resection of stomach and D I I resected stomach anastomosis and jejunum

Fig 22 1 Duodenal stump B papilla C end-to-end anastomosis of jejunum D typical end-to-side anastomosis lower half of stomach to jejunum

freedom from symptoms has continued now over a period of 9 years

If in these 2 cases the so called predisposition to ulcer had been the cause of the repeated relapse, surely the last resection would not have brought about permanent healing. In the first resection for the gastrojejunal ulcer too little of the stomach was removed (half of the dilated stomach had been left behind) so that a marked hyperacidity continued, but in the last resection so much of the stomach was removed that the gastric contents were anacid and therefore when the gastric contents touched the jejunal loop lying above the entero anastomosis where there is no bile or pancreatic secretion to act as a neutralizer, no harm came to the loop due to the anacidity. Had these

contents been acid, there is no question but that another ulcer would have formed. That is undoubtedly the reason both patients have remained healed in spite of the Y anastomosis which in most cases of gastrojejunal ulcer gives a very poor permanent result. In our material 22 such anastomoses show 8 recurrences (Figs 20 and 21).

Much has been written about the "surgically incurable ulcer." From the material of the Hochenegg Clinic, Mandl cites cases in which three or four operations have been done without affecting a cure but this does not prove that the condition was incurable because an extensive radical operation had not been done in these cases. One of the cases cited as being surgically incurable after three operations without permanent healing has been symptom free for 10 years following a fourth operation—the typical, radical removal of two thirds of the stomach—done in this clinic.

In these cases of recurring ulcer, if one removes a sufficiently large portion of the stomach extends the resection to the typical points as described in this paper, instead of making a Y anastomosis, unites the jejunum end to end, and then makes the typical end to side anastomosis between the stomach and jejunum distally to the circular suture of the jejunum, he will succeed in making the patient symptom free as proved by our own experience (Fig 22).

Considerable has been written, notably by von Haberer, against extensive stomach resections because of the reduced size of the remaining stomach. The objection advanced is that a patient with a stomach so reduced in size cannot eat a full meal without having palpitation of the heart, dyspnea, fullness, nausea, etc. It is possible that this may occur in the first few weeks following operation but these phenomena will disappear at once if the patient will lie down for 5 to 10 minutes after eating. After 2 to 3 months the patients are able to eat meals of normal size without any discomfort. Prior to this time it is perhaps better for the patient if he eats smaller meals at shorter intervals, for example, every 2 hours. The symptoms attributed to the reduced size of the stomach disappear, because the jejunal loop used in the anastomosis gradually dilates, sometimes even to the size of an arm and to as much as 50 centimeters in length, but not because of any stretching of the stomach stump. This we have seen in cases which have been reoperated upon later for other conditions and the stomach investigated. On one particular instance, the patient died of a sarcoma of the ileum 9 years after a stomach resection. Autopsy showed a

tremendous dilatation of the jejunum without any adhesions

The discomfort from a stomach reduced in size would surely persist if the intestine were not able to expand. As an illustration, in the Billroth I type of operation or the von Haberer modification where the duodenum is embedded in adhesions and partly retroperitoneal, the stomach cannot dilate itself to such a degree as the perfectly free and mobile jejunum. The symptoms can also persist in a case in which numerous adhesions in the afferent loop, subsequent to local peritonitis especially after repeated operations, hinder the evacuation of the jejunal loop.

In our material, we have encountered complaints due to a reduction in size of the stomach more frequently after the Billroth I type of operation or the von Haberer modification (20 per cent of cases.) Although in these methods much less stomach is removed, still the duodenum cannot dilate in like manner, as the jejunum does in the typical end-to-side stomach anastomosis. In the latter type of operation only 5 per cent of cases have any symptoms which might be attributed to the reduced size of the stomach. In none of the cases, however, were the symptoms severe as all were able to work and were pleased in that they were free from their former pain and that it was unnecessary for them to live on a diet. Only when the patients were pointedly asked if it were possible for them to eat large meals without discomfort did some mention that it was not possible, otherwise it would probably have passed entirely unnoticed.

If there exists any definite sequelæ secondary to the extensive resection it has not been found here. It has been mentioned in literature that these patients suffer from a chronic diarrhœa, the inciting cause being the changed physiology of the stomach following the extensive resection. This we have seen in only 2 cases, and in these cases only when certain foods were eaten did symptoms occur.

The occurrence of pernicious anemia following extensive resection has also been mentioned in the literature but in our material there has been only one such case. This occurred in a man 55 years of age in whom an extensive gastric resection was done while the patient was in a stage of severe anemia due to repeated hæmorrhages from a duodenal ulcer. The blood picture was erythrocytes, 700,000, leucocytes, 10,000, hæmoglobin, 30 per cent. Two years later this man was seen on a medical ward, suffering again from repeated hæmorrhages and a diagnosis of recurrent gastrojejunal ulcer was made. At operation no ulcer

was found but there were multiple small angiomata in the jejunum. This patient died one month later and the pathologist made a diagnosis of pernicious anemia from the findings in the bone marrow but which was not concurred in by the internist staff because of the blood picture and the clinical symptoms. If it should be shown some time later that an extensive stomach resection played any part as an etiological factor in the production of a pernicious anemia, then surely we would be compelled to abandon this method for a less extensive resection even at the risk of a higher percentage of recurrent gastrojejunal ulcer. However, in a large number of resections, we have as yet to meet this experience.

SUMMARY AND CONCLUSIONS

1. The resection of an ulcer of the anterior wall of the duodenum is technically neither difficult nor dangerous and therefore can be performed by surgeons of more limited experience.

2. The resection of a duodenal ulcer penetrating into the pancreas is more dangerous because of the possibility of injury to the pancreas or the accessory pancreatic duct causing an acute pancreatitis, but this danger is less if the ulcer is not excised from the pancreas like a malignant tumor. Instead it is far better to detach the margin of the duodenum from the floor of the ulcer and leave the latter *in situ*. In all of these cases drainage is absolutely essential. If the penetrating ulcer extends far out toward the papilla or if the common bile duct cannot be isolated from the callus infiltration of the ulcer then it is best to do the resection for exclusion. In such a case the pylorus should be removed only if the first part of the duodenum is free so that a safe and sure closure of the duodenum can be made.

3. In order to obtain satisfactory permanent results, resection of the stomach on the lesser curvature must be made in the vicinity of the cardia where the left gastric artery leaves the cœliac trunk and approaches the stomach. On the greater curvature it must be made a hand's breadth to the left of the middle point of the curvature so that in the case of a normal sized stomach two thirds is removed and in a highly dilated stomach three fourths is removed. At any rate only the cardinal third of the stomach must be left.

4. The most reliable anastomosis is the Hofmeister Finsterer modification of the Billroth II method in which all the drawbacks of the original method are eliminated and retrograde filling is prevented. An entero anastomosis between the pars ascendens duodeni and the jejunal loop will

always overcome retrograde filling but this anastomosis should be avoided as it predisposes to a gastrojejunal ulcer above the anastomosis, if the gastric contents are acid

5 Insufficiency of the suture line is avoided in a carefully made three layer suture and because in the Hofmeister Finsterer operation the freely movable jejunum is never under tension and therefore there is no pull on the suture line

6 The Billroth I method and also von Haberer's modification of it does not adapt itself well to an extensive resection without danger of suture insufficiency due to tension, and if the resection is not extensive then there is the danger of a recurring ulcer. With the Billroth I method in a case in which there is a narrow duodenum, in spite of a careful suture, a stenosis is possible and therefore this operation should be done only when there is a wide and freely movable duodenum

7 The mortality in gastric resections can be held low even in unselected cases by avoiding ether narcosis and by careful after treatment. In the past 10 years the mortality in 566 resections for duodenal ulcer has been 3.1 per cent, in the typical end to side anastomosis or Hofmeister Finsterer modification of the Billroth II, 2.3 per cent, in the Billroth I or von Haberer modification

of it, 5.8 per cent, in the resection for exclusion, leaving the pylorus *in situ*, 2.1 per cent, in the same operation but removing the pylorus, 14.7 per cent. The high mortality of the latter method can be much reduced by adopting routine drainage

8 The permanent end results are due to the extensiveness of the resection, therefore, they are equal in result in the resection for exclusion even if the pylorus is left. In duodenal resection 93.4 per cent of healed cases compares favorably with 90 per cent in the resection for exclusion. Therefore, in non-resectable ulcers of the duodenum the resection for exclusion should be preferred to the simple gastroenterostomy in which only from 40 to 60 per cent of cases are free from symptoms after operation

9 Relapse of the duodenal ulcer or recurrence of a gastrojejunal ulcer is due to an insufficient resection but can be cured by a re-operation which must be extensive. The Y shaped anastomosis should be avoided, however, because of poor results

10 The term "surgically incurable ulcer" is a misnomer because in all cases of recurrent gastrojejunal ulcer operated upon radically at this clinic, permanent healing has been obtained

FROM THE SURGICAL CLINIC OF THE BENEFICENCIA PORTUGUESA

DIAGNOSIS AND TREATMENT OF ACUTE INTESTINAL OBSTRUCTION

JOSÉ MENDONCA, M D, F A C S (Hon.), RIO DE JANEIRO, BRAZIL

Ex Chief Surgeon Hospital da Beneficencia Portuguesa ex Surgeon Santa Casa de Misericórdia

IN the presence of an obstruction to the passage of matter through the intestinal tract giving rise to acute symptoms, we must endeavor to determine, first, whether the obstruction is a dynamic (spasmodic or paralytic) or a mechanical one, which may be caused by the accumulation of compact matter, by volvulus, by atresia of an intestinal segment, by adhesions, by stenosis, by intrinsic or extrinsic tumors, by strangulation of intestinal loops in any one of the abdominal orifices (internal, external, normal or pathological), by invagination, or other such conditions.

The causes of dynamic ileus are so numerous that we may say that any traumatism or pathological state capable of disturbing the nervous system deeply can produce it. Crushing of the limbs, traumatism of the brain or spinal cord, twisting of the pedicle of abdominal organs or tumors, prolonged handling of the intestine during operations, disease of the nervous system, gastrointestinal intoxication, renal or hepatic colics, peritonitis by mere irritation or infectious (perforation or inflammation of abdominal organs), syphilitic infection, and some poisoning (lead, curare, timbó, etc.) may paralyze or cause spasms of the intestine sufficiently powerful to interfere with the course of the fecal matter and gases.

To make a differential diagnosis between dynamic and mechanical obstruction, we must at first secure an accurate anamnesis, letting the patient speak in his own words, never correcting his expressions, keeping him under observation, if possible, for hours, examining at short intervals, and utilizing such therapeutic tests as do no harm to him. Through the anamnesis we may secure information about any difficulties preceding the acute onset and this information will help us in determining whether the ileus is of a dynamic or mechanical nature. Through such information we may discover habits and morbid conditions capable of causing stasis. Though there be no atresia of the intestine, we may discover a local lesion that by its development can produce obstruction. Finally, such information may reveal that previous operations have been performed and that there are now present adhesions or stenoses.

The diagnosis of ileus is so complex that in most cases one examination alone is not sufficient. It is

necessary to observe the patient for as long a period as the circumstances permit and to repeat the examination combined or not with the therapeutic test.

We begin by observing the facies, respiration, pulse, condition of the heart, sweating, temperature (general and local of the abdominal wall and the extremities), and diuresis, by noting the mechanism, quantity, nature and frequency of vomiting, by noting the seat and character of the spontaneous pains, by observing the abdomen, noticing the volume, form, movements and the modification of the cutaneous blood supply, by palpating to determine tension, muscular defense of abdominal wall, peristaltic movements, dilatation of intestinal loops, the presence of tumors or inflammatory impaction, and the increased sensitiveness of the abdominal regions, by percussion to discover tympanites (localizing it if possible) and to determine whether the normal areas of dullness have disappeared, by auscultation to perceive borborygmi and arterial murmurs (I have seen an aneurism of the superior mesenteric artery cause obstruction), and, finally, when indicated, we resort to the therapeutic test. This test consists in giving hypodermically morphine, atropine, pituitrin, etc., in giving enemas, and in using locally heat or cold, according to the general temperature.

The latest advances in roentgenography make it possible, in almost all the cases, to obtain data to confirm the diagnosis.

Some surgeons consider it a crime to give morphine in the presence of an intestinal obstruction. Is this right? Certainly, if the patient is intoxicated and has a low blood pressure. However, if collapse is caused by violent pain or the intestinal paralysis is caused by a renal or hepatic colic, morphine is unquestionably indicated.

Differential diagnosis between dynamic and mechanical ileus is summarized in Table I.

If we decide that we are dealing with a mechanical ileus, it is of great advantage to know the site of the obstruction, for then the operation becomes easier since, without loss of precious time, we may succeed if we bear in mind the anamnesis and make a scrupulous analysis of the symptoms. Experience teaches us that the fatal outcome and the

TABLE I—DIFFERENTIAL DIAGNOSIS

DYNAMIC ILEUS

MECHANICAL ILEUS

DYNAMIC ILEUS

MECHANICAL ILEUS

Previous existence of a nervous condition that may cause spasm or intestinal paralysis. Severe pain sufficient to cause a deep alteration of the nervous function. Traumatism of the nervous centers. Infectious diseases such as peritonitis, meningitis, pancreatitis, appendicitis, etc. Intoxication and poisoning (lead, curare, tumbó, etc.). Absence of any previous and local lesion that might cause mechanical obstruction.

Depending on the disease that caused the obstruction: abdominal in generalized peritonitis, twisting of pedicles, etc. and generally normal in local peritonitis without severe pain, salpingitis and appendicitis without great repercussion on the peritoneum, etc.

The same as in the disease that caused the ileus. A low tension without general peritonitis, intoxication or violent pain is an exceptional condition.

The same as in the disease that caused the ileus.

Is dependent on the disease that caused the ileus.

Uncommon but frequent and resistant to treatment when there is peritonitis. Never fecaloid, if there is no peritonitis.

Anamnesis

Constipation or diarrhea associated with tympanism and local pain. Existence of a lesion that by its evolution may cause obstruction. Previous existence of hernia or calculous cholecystitis. Swallowing of foreign bodies that may obstruct the intestine.

Facies

As a rule normal during the first 48 hours and altered after this time except in high obstruction of the small gut, strangulation and peritonitis as an initial complication when the facies is soon altered. In rare cases of low obstruction we may observe a composed facies for 7 or more days.

Pulse

If there is no strangulation, volvulus or other lesion causing a deep alteration of the nervous system, the pulse is normal or almost normal and of good tension but as the infection progresses the pulse becomes rapid and of low tension.

General Temperature

Normal at first. It rises progressively as the intoxication increases. When peritonitis is a complication the temperature is high or low according to the case.

Local Temperature

Normal as a rule.

Vomiting

The frequency and type depending on the height of the obstruction.

Tympanism

Permanent or not it is found in all kinds of obstruction. The presence of gas in the peritoneal cavity is rather a sign of perforation of the stomach or the intestine.

Abdominal Pain

Absent, spontaneous or provoked, local or general according to the disease that caused the ileus.

Always present. Increases progressively as time passes and decreases only by belching.

Pain only during contraction of the intestine to overcome the obstacle or when peritonitis complicates the obstruction.

Respiration

Varying according to the disease that caused the ileus.

If there is no severe pain at first normal, in peritonitis or after great distention of the abdomen breathing becomes thoracic, superficial and frequent.

Peristalsis

Increased in spasmodic ileus and diminished or abolished in the paralytic type.

Always increased and associated with borborygmus audible at a distance decreased or absent when the ileus is complicated with peritonitis or the disease is in its last period.

Shape of the Abdomen

More or less distended according to circumstances.

The abdominal wall is uniformly distended but the presence of greatly distended loops or tumors may cause protrusions.

Diuresis

If the disease that caused the ileus does not present especial characteristics diuresis is in inverse ratio to the increasing intoxication and the frequency of attacks of vomiting.

Grows less and less if the obstruction is not removed; the urine becomes concentrated and nephritis appears.

Permeability of the Intestine

Restored when the disease that caused the ileus is cured.

Restored when obstruction is removed.

Severity of the symptoms vary with the distance of the lesion from the pylorus, that is, the nearer the lesion is to the pylorus the more rapidly fatal is the outcome and the more violent the symptoms. Experience also teaches us that the obstruction is probably located at the site of some lesion which causes an obstruction as it develops.

Therefore, in obstruction of the colons, except in cases of strangulation and volvulus, the progress of the disease is slower and the symptoms at first much less violent than in obstruction of the small intestine, the abdominal distention increases little by little, percussion reveals distention of the cæcum, and by auscultation it is noted that the murmur of the gaseous waves comes from the median line in the direction of the right iliac fossa and there disappears.

If the obstruction is located in the descending colon, sigmoid flexure, or the rectum, we discover that the shape of the fecal matter has been modified and that the patient has had attacks of diarrhoea. In such cases enemata are expelled as soon as they are introduced.

If the obstruction affects the small intestine, the general condition of the patient becomes worse, the circulatory apparatus becomes insufficient, peristalsis increases, and tympanism and intoxication develop more rapidly. From the onset the colics are more intense and the waves formed by the distended loops more perceptible. Distention of the abdomen, though less extensive than when the colons are obstructed, appears sooner.

TREATMENT

In treating a patient with intestinal obstruction it is essential first to improve his general condition. Though he is seen at the very onset, if he is in collapse, we must try to build up his strength before operating. To accomplish this, hypertonic salt solution is injected to restore the fluid content of the tissues, morphine is administered to relieve pain, and heart stimulants are given to maintain the myocardial tonus.

If, however, the disease is in its last stages, that is, if the symptoms of stercoræmia are established, the treatment must then be directed against the intestinal stasis, the insufficiency of the hepatic cells, the tendency to anuria, and the peritonitis that is frequently present at this time.

Stasis is eliminated by establishing an artificial anus. This operation is performed under local anæsthesia and the anus is made on the small intestine, appendix, the cæcum or colon, or, if impossible to choose, the easier obtainable dilated loop is used. To restore the function in the hepatic cells and to correct the tendency to anuria, hypertonic serum—glucose and insulin (250 cubic centimeters of serum glucose and 10 units of insulin per dose)—is injected and nourishing liquids are given in small amounts.

When glucose and insulin are used, it is necessary from time to time to analyze the urine and blood, if glucose is found in the urine, the



Fig. 1. Roentgenogram showing distention of the intestine.

glucose solution is discontinued and hypertonic salt solution is substituted. If the percentage of glucose in the blood is below normal, the insulin is discontinued and glucose solution is used. Lavage of the stomach and intestine with physiologic serum through a tube introduced through the mouth or through the abdominal fistula helps to lessen the intoxication. Heart stimulants and the local application of heat or cold, depending on the general temperature, are advantageous in peritonitis, and if the condition is infectious, sera and vaccines are indicated. Should the peritonitis be so advanced as to produce pus, it is necessary to open and drain the purulent collections.

In these extreme cases, it is possible to arrive at a more or less definite diagnosis. We must endeavor to determine whether the ileus is a mechanical or dynamic one. If dynamic, the treatment is principally that for the affection which has caused the ileus. If there is present a peritonitis, inflammation of the abdominal organs, twisting of the pedicle of tumors or organs, violent colics (hepatic, renal, ovarian, etc.), thrombosis of mesenteric vessels, nervous disease, etc., the treatment is that for these affections, together with enemata and drugs to relieve the spasm or to restore the peristalsis when there is no peritonitis. In mere paralytic ileus, electricity is a good stimulant.



Fig 2. Roentgenogram made after enema of citoharum. Obstruction is seen close to splenic angle of colon indicated by arrow.

Generally speaking in dynamic ileus surgical intervention is indicated only when the condition that caused the ileus calls for operation or when intoxication is so advanced that drainage of the intestine is an absolute necessity.

A brief report of 4 cases from my clinic may be of interest in a discussion of this subject.

A man of strong constitution aged 40 years entered the hospital of the Beneficência Portuguesa complaining of pain in the upper part of the abdomen and frequent attacks of vomiting. The vomitus was acid and was sometimes stained with bile. He was unable to retain anything in the stomach. Antiemetic and sedative drugs produced no alteration in his condition. When I saw him in consultation with his assistant surgeon he was deeply depressed and had abdominal facies; the pulse was weak and frequent though serum and heart stimulants were liberally given. Pain and vomiting came at short intervals. The abdomen was not distended and there was no pain or muscular rigidity on palpation. Because the medical treatment had had no effect laparotomy was done. There was no peritonitis but there was found a cord like contracture extending about 20 centimeters in the highest part of the jejunum. In this area peristaltic movements were seen. The intoxication increased and the patient died the next morning.

The second case may be considered as one of traumatic paralysis. A man operated upon for a strangulated inguinal hernia presented the morning after operation a very distended abdomen with a point close to the umbilicus sensitive to pressure. No feces or gas was passed by anus. Paregonic elixir was given by mouth and a warm cataplasm

was applied to the anterior abdominal wall. Twenty four hours later the patient passed feces and gas.

Another man aged 32 years of good constitution was operated upon for a chronic appendicitis which had presented the characteristic colic and nausea syndrome. Two days after operation the patient presented a marked gaseous distention of the abdomen. He had no fever or pain but he did have difficulty in breathing and an accelerated pulse though of good volume. He looked like one of those toads that swell by swallowing air. Pituitrin was given and gas was expelled. However the abdomen soon became swollen again. As the Wassermann was found to be positive we resorted to intravenous injections of oxymercure of mercury. The tympanism disappeared. This was a case of dynamic ileus caused by syphilitic infection.

The fourth case presented a peculiar obstruction which had lasted for 5 days and was caused by renal colic. A manufacturer aged 62 years constipated and with lightly icteric skin became ill February 17 1930 with spontaneous pain in the left loin and the same side of the hypogastrium. He passed urine frequently but in small quantities. The specific gravity was 1030. No sugar or albumin was found in the urine. He was given a sedative and as it produced no relief sedol was injected. The pain decreased but though the abdomen began to swell it was not tense. An enema brought some feces but had no effect on the tympanism. The morning temperature was 37 degrees C and the evening temperature 37.5 to 38. No effect was obtained from a dose of magnesium and nujol. The gas did not pass through the anus but was expelled by mouth. The patient at first vomited and was salivated. When I saw him in consultation with his physician on the morning of the 22d he had a temperature of 37 degrees C and a full pulse of 80. The abdomen remained distended and was sensitive to palpation on the left side. By percussion we perceived that the cecum and right angle of the colon were distended with gas. The small intestine was less dilated than the colon.

The peristaltic contractions were at times associated with pain and during such contractions a murmur of shaken liquids and gas could be heard. The gaseous waves were in the direction of the cecum and there they were lost. We had the impression that the obstruction might be in the left colonic angle. There was no dyspnea but breathing was somewhat accelerated. We advised the following enema: infusum chamomile 2 liter castor oil 80 grams essence of turpentine 4 grams and an egg yolk to make an emulsion. Twenty minutes after the enema the patient emitted gas liquid feces and mucus stained with blood. The distention of the abdomen disappeared.

Radiographic examination revealed in the first film distention of the intestine but no calculus in the urinary tract. After an enema of citoharum we took a second film in which we could see an obstruction close to the splenic angle of the colon (see arrow Fig. 2). The opaque substance had reached the ascending colon. A third film (Fig. 3) with the anterior abdominal wall of the patient on the table showed that the obstruction was a block of fecal matter (see arrow). Soon after the examination patient passed the enema and during the night he had abundant bowel movements. The urine was condensed and in suspension showed crystals of uric acid. The abdominal symptoms disappeared but the pain remained in the left loin. Relief was secured by hot baths and allonal.

If we are dealing with a mechanical obstruction and the enemas fail to restore the permeability of the intestine, we must resort to laparotomy as soon as possible.

When the exact position of the obstacle is known the incision should be placed over it, if the position is not known, it is better to cut the anterior abdominal wall in the median line, with the umbilicus as a center. When the latter incision is used it must be long enough to permit the inspection and handling of any part of the intestine. First, the abdominal cavity is inspected. An abnormal amount of liquid and a hyperemic peritoneum indicate peritonitis, if the liquid contains bile, urine, feces, or alimentary particles, the gall bladder, urinary bladder, intestine, or the stomach is perforated. Blood stained liquid is a sign of stasis and pure blood indicates an internal hemorrhage. Venous stasis and necrosis of the intestinal wall indicates an obstruction of the mesenteric vessels. In pancreatitis, coagulation of the fat in the mesentery and epiploon is found.

If the stomach is distended, the obstacle is situated on the pylorus or duodenum. If one portion of the small intestine is distended and the other collapsed, the obstruction is found between them. A dilated cecum is a sign of obstruction of the large intestine.

To reach the obstructing lesion it is preferable to follow the empty loops and to avoid dislodging the dilated ones which are always difficult to replace. When the obstruction is caused by gall stones, foreign bodies, fecal lumps, or benign pedunculated neoplasm, incision, removal of the obstacle, and suture are sufficient treatment. If, after dissecting bands or adhesions, the surface of the loop is stripped of peritoneum, it is better to do a resection. Resection is also indicated in the presence of irreducible invagination, malignant tumors, volvulus, deep and diffuse tuberculosis, syphilitic gumma, etc. Obstruction of the mesenteric vessels is the worst condition that the surgeon encounters for he never knows the exact extent of the disease and has to rely somewhat on luck in doing the resection. If the local or the general conditions do not permit a radical operation, and intestinal fistula may be placed above the obstruction.

After the obstacle is removed the cavity, if soiled, is cleaned with wet gauze and the wound is closed with or without drainage, according to the condition of the peritoneum. Evacuation is done only when it is impossible to do otherwise. If marked gaseous distention of the intestine hinders the reduction of the intestinal loops, our method of choice is to remove the gas and liquids by means of needles and an aspirator. An incision of one or more loops to empty the gut of feces is a very hazardous procedure if the peritoneal cavity is widely open. It is preferable

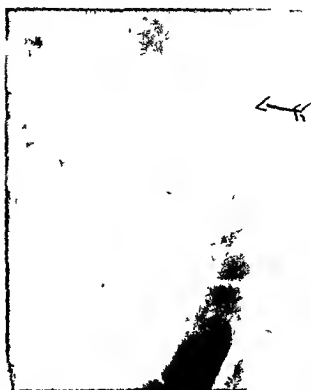


Fig. 3. Roentgenogram with patient's anterior abdominal wall on table. Obstruction indicated by arrow.

to close the peritoneal wound and leave exposed a portion of the loop which has been selected to open immediately or some hours after operation. The emptying and washing out of the intestine is done through the artificial anus, if necessary, with the aid of a catheter.

Should the general condition of the patient make impossible radical intervention, an artificial anus must be made to enable the surgeon to wait for a better occasion.

Dehydration of the tissues is an ordinary occurrence in patients with intestinal obstruction. It is caused by vomiting and the fact that it is impossible for the patients to retain liquids. Hepatic, renal, and nerve function is low for the same reason and because toxins are retained in the plasma. Under these circumstances hypotonic salt solution is given to check the loss of liquid, glucose solution and insulin are injected to restore the hepatic function and to make more nearly normal the plasma contents, and heart tonics are given to stimulate the myocardium.

Finally, the washing out of the stomach and large intestine is very helpful in removing the intoxicating substances.

SUMMARY

1. An acute intestinal obstruction may be dynamic or mechanical.

2 A careful anamnesis, a meticulous examination and due consideration of all the symptoms enable us, in most cases, to determine the type of ileus in a given case

3 The operation is easier and associated with less danger if we know the exact site of the obstruction. When the pain and tympanism have become localized, when the previous history of the disease is obtainable, when the symptoms are appreciated, and when local appearances are characteristic, it is then usually possible to determine the exact location of the obstruction

4 With regard to treatment, two conditions demand urgent measures: the initial collapse and the late intoxication, associated or not with peritonitis caused by infection through the

intestinal wall. In the first, it is necessary to increase the strength of the patient by means of medical agents, before operation is done, in the second, we must combat the intoxication and relieve stasis, an artificial anus being made with the aid of local anæsthesia. Radical operation must be postponed

5 Even in these urgent cases, we have sufficient time to make a diagnosis before operating

6 If we have any doubt about the recidivation of the obstruction, it is preferable to resect the affected part of the intestine

7 As we have to do with dehydrated and toxic patients, it is indispensable to have at our reach hypertonic salt solution, glucose solution and insulin

THE TREATMENT OF PELVIC CELLULITIS

SURGICAL DRAINAGE OF PARAMETRIC EXUDATES

MARION DOUGLASS, M D, F A C S,¹ and DEAN SHELDON, M D, CLEVELAND, OHIO

THE management of pelvic infections which result in parametric cellulitis is often a most perplexing problem. The occurrence of a parametric exudate enforces upon the patient a long and serious illness, which, when treated by an expectant regimen, gives slow and often disappointing results. Such infections are most frequently seen as a sequel to postpartum infection but occur as a complication of many pelvic operations also. In selected cases, surgical drainage apparently offers striking, immediate relief from symptoms and a shortened period of morbidity. We wish to give the clinical results of a series of 10 cases in which broad ligament infections were drained by the method proposed by Cullen.

Puerperal infection, recognized and unmistakably described by Hippocrates, is still a dangerously prevalent disease of parturient women. Although it has been recognized since Semmelweis and Holmes that the hand of the accoucheur is the most frequent source of infections, the incidence of postpartum infection is alarmingly high, especially in this country. Pelvic cellulitis is one of the graver manifestations of puerperal infection, represents commonly extension of an infection of the endometrium, and is a reaction of the pelvic connective tissue to bacterial invasion. The extension of infection from the endometrium or from lacerations in the cervix occurs through the lymphatics leading to those nodes situated principally in the broad ligament regions. Many varieties of organisms have been associated with puerperal fever, principally, types of streptococcus, staphylococcus, bacillus coli communis, and many varieties of saprophytic cocci and bacilli, both aerobic and anaerobic. Sterile cultures result in a surprising number of cases and smears show few organisms in some cases. Williams having taken cultures from the uterine lochia of 324 cases presumably having postpartum endometritis, found 68 which were sterile.

The frequency of broad ligament exudations is difficult accurately to estimate. Many of the milder varieties of these cases escape unrecognized, and the patient who has a postpartum febrile reaction and develops a small exudation in the cellular tissue in the broad ligament, which never becomes very large or is obviously an abscess, is usually not diagnosed. Such mild cases

resolve spontaneously after an unexplained short febrile course.

Puerperal infection is frequently complicated by femoral phlegmasia alba dolens but our experience leads us to agree with Polak, who states that pelvic cellulitis, acute or chronic, is, next to endometritis, the most frequent pathological lesion found in puerperal infection.

The extension of infection from the uterus or from tears to the cervix produces, as a rule, a fairly typical clinical picture. There is a preliminary elevation of temperature which may or may not subside and ends after a day or two. Several days later there is usually a chill, a high elevation of temperature, and abdominal pain either on one or both sides. Either a vaginal or an abdominal examination may reveal a tender spot and a palpable mass in the broad ligament. Extension may occur anteriorly dissecting the peritoneum from the anterior portion of the bony pelvis and the abdominal wall, or less often it may extend backward toward the retroperitoneal region. The clinical course of these cases is usually protracted, and there are often repeated chills. There is daily elevation of temperature, an accelerated pulse, and elevation of the white count. Certain of our cases, however, had slight temperature, practically no leucocytosis, and complained solely of abdominal pain. The exudate is hard and fixed and it is often difficult to make a diagnosis of abscess even when the interior of the mass may be filled with pus. The febrile reaction may continue for weeks before resolution takes place, if the drainage is not instituted. Septicæmia and the spread of the infection to the peritoneum are the most serious dangers which threaten, and against which the surgeon must be on his guard. Repeated pelvic examinations should be avoided.

The patient should be placed in the Fowler position and made comfortable with sedatives. We have employed, with apparent good effect, external heat as suggested by Polak and Gellhorn, in the form of moist abdominal stupes frequently changed. The wisdom of drainage of these cases is questioned by many unless there is frank pointing of an abscess. Polak states that only 6 to 7 per cent of these parametric exudates suppurate and that the vast majority end in resolution. Observation of these cases has led us to employ

¹ From the Department of Obstetrics and Gynecology of the Western Reserve University School of Medicine and the Lakeside Hospital.

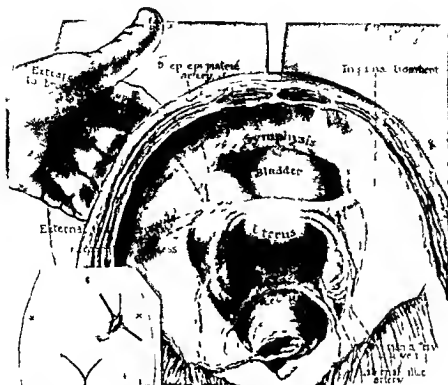


Fig. 1. Diagrammatic view of the extraperitoneal approach to the infected area in the broad ligament region as advocated by Cullen. The insert shows the site of the inguinal incision.

the method suggested by Cullen in 1917, i. e., of incision just above Poupart's ligament and drainage of the exudate from between the folds of the broad ligament without opening of the peritoneum. This procedure we have employed on the following indications: (1) when there is definite fluctuation of the parametric mass; (2) when there is a solid exudate of considerable size suggesting the possibility of there being a collection of pus within it. If the patient is running a febrile course and is very ill, especially if the blood sedimentation time is low, we believe incision and drainage to be desirable unless the inflammatory mass is quite small. We have not, as a rule, operated upon patients until they have been under observation from 5 to 6 days, unless there has been outspoken fluctuation and obvious pointing of a parametric abscess in a given direction.

The question of draining a cellulitis in the pelvis presents the same problems from a surgical standpoint that cellulitis does anywhere else. As every operator is aware, incision of any inflammatory mass occasionally precipitates a septicæmia. The beneficial results of incision and drainage of infection in this area, however, in our experience far exceed any harmful effect. The time for inter-

vention in the individual case is a matter of clinical judgment. Patients with large parametric exudates containing as much as 400 to 600 cubic centimeters of pus are sometimes almost afebrile yet have tedious and painful convalescences if one does not operate until he is certain of fluctuation. De Lee, Williams, and others advise drainage of frank abscesses but many times the patient may waste away and die of exhaustion before an abscess points. Early drainage of indurated areas will often abort them and foci which have persisted for months will often clear up rapidly after incision. From the standpoint of safety, as emphasized by Cullen, the extraperitoneal approach is greatly preferable to transperitoneal drainage inasmuch as these abscesses may contain virulent streptococci, which are capable of producing a rapidly fatal peritonitis. Drainage through the cul de sac of Douglas or the lateral fornices of the vagina is undesirable because there is danger of injury to ureters, uterine vessels or contamination of the peritoneal cavity.

OPERATION

After a definite diagnosis of parametric cellulitis is made, especially if there is fluctuation or a

suspicion of fluctuation, incision is made about an inch above and parallel to Poupert's ligament (Fig 1). The parametric masses often feel continuous with the uterus, extending into the lateral fornices but may be detached from it. They feel, upon vaginal touch, as if they were close to, or almost inside, the anterior abdominal wall in contrast to a tubal or tubovarian mass which is usually definitely posterior to the uterus upon palpation. The external oblique aponeurosis is opened in the line of its fibers and the conjoined tendon is identified. The pulsation of the deep epigastric artery may be made out and by gentle blunt dissection, the cellular tissue under the conjoined tendon and above Poupert's ligament may be thrust back. Lateral and below, the femoral artery can be felt pulsating and a safe margin for the femoral vein which is medial to the femoral artery must be kept in mind. The finger is pushed down close to the wall of the bony pelvis but crooked posteriorly, pointing in a medial direction in order to escape damaging the femoral vessels. Little pressure usually is required and there is practically no bleeding. The mass may be readily felt by the examining finger, pressure being made upon the corresponding lower quadrant of the abdomen with the other hand.

The finger is lateral to the ureter, the deep epigastric artery is above or may be just medial, the femoral vessels are lateral (Fig 1). When the examining finger touches the inflammatory mass, if the wall is very thin, the finger may be pushed into the mass the wall of which is perforated easily, although the mass appears to be solid. Two drains are placed down through the sinus thus made into the broad ligament region. As frequently happens when opening abscesses, the operator finds that the abscess cavity has been entered before he is aware that it is being perforated. This, however, is of no consequence if his anatomical orientation is exact. A large amount of pus is often evacuated although the abscess wall may have been hard and resistant. A small gush of serum is sometimes all that follows immediately. Drainage usually becomes more profuse in the course of a day or two, and the condition of the patient usually improves markedly. The increase in drainage, of course, is doubtless due to some extent to the tissue reaction to the foreign body, to the trauma of the procedure, and to the introduction of drains into a sinus tract which presupposes infection from without. However, the improvement in the general condition of the patient has, in our experience, almost invariably seemed synchronous with the operative intervention.

Williams states that incision into parametric cellulitis with evacuation only of a small amount of serum frequently gives as good results as if large amounts of pus were encountered. The true in cellulitis in general. The external incision is closed with interrupted sutures of catgut gut fairly snugly about the cigarette drains. The drains are moved on the second to the fourth day and are shortened steadily each day. They are removed about the sixth to eighth day. The incision often drains slightly for 2 to 3 weeks.

CASE SUMMARIES

CASE 1. P. R., aged 25, was admitted to the hospital January 10, 1930, and was discharged February 10, 1930. The patient, a colored female, complained of pain in the right side of 5 weeks' duration. While taking a walk she was seized with severe pain in the lower abdomen, very weak, and fainted. Some vaginal bleeding occurred at this time and she was in bed 5 days. The patient's general health was poor. A mass had been excised several months ago. She had had no operations. Patient had had pneumonia and thinks she had a neisserian infection 1 year ago. There was intermittent pain in the right side for 2 years. She began at the age of 13, were regular, and lasted 3 days. She had a miscarriage at the last menstrual period, December 1, 1929. Family history was negative. Physical examination revealed a poorly nourished colored girl. She looked very weak and pale. Chest was clear. There was an ovoid mass the size of a grapefruit of the midline extending nearly to the umbilicus. This mass was fluctuant and tender. It was trophied and pushed anteriorly, the uterus was there was a large mass in the right upper quadrant in the left. The Wassermann was negative. Hemoglobin was 78 per cent, red blood cells 3,300,000. Papanicolaou oophorectomy, posterior plasty, and salpingectomy were performed. Convalescence was uneventful after operation. The tenth day after operation the temperature reached 40 degrees. Patient was discharged. Broad ligament was found an abscess extraperitoneally. Two cigarette drains were placed. Course was uneventful after this. The patient was discharged on the twenty third day. The method of drainage is often valuable in the treatment of traperitoneal accumulations of pus after operations for tubal disease.

CASE 2. A S., aged 20 years, was admitted to the Hospital, March 10, 1930, and was discharged March 20, 1930. The patient, a white woman, 6 feet 1 inch tall, had been present in the hospital immediately following delivery of a child which had been very severe for a few days. She was profuse leucorrhoea, dyspareunia. On January 23, 1930, she was diagnosed of postpartum infection and treated expectantly. At this time she was made. She was readmitted to the hospital because the abscess extraperitoneally. The family history was unimportant. She had a well developed but small uterus. There was tenderness in the right lower abdomen. Temperature was 38.2 degrees. The cervix lacerated.

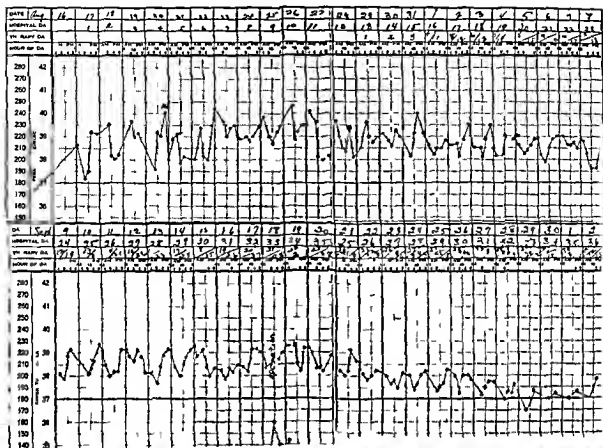


Fig 2 Case 9 Temperature chart of a typical case of pelvic cellulitis showing the unremitting character of the fever a month prior to operation and prompt defervescence after operation

anterior but pulled to the right and there were very tender fluctuant masses in both lateral vaginal vaults. Laboratory findings were negative. On March 11, 1930 drainage of the left broad ligament abscess was done. About 200 cubic centimeters of thin brownish fluid was obtained culture of which was negative for 48 hours. A cigarette drain was inserted into the wound in the groin. The temperature never arose beyond 38.5 degrees. The patient was discharged from the hospital on the eighth day after operation and is to return to the dispensary for further observation. The small erudate on the other side cleared up spontaneously.

CASE 3. M. R. aged 32 years was admitted to the hospital August 22, 1929 and discharged September 27, 1929. The patient, a negro, came to the hospital because of pain in the left side since an abortion 1½ months before. A week ago the pain became generalized in the abdomen. She had had fever for the past week with dysuria and frequency. The past history was negative. The last menstrual period was April 29, 1929 and the previous period March 21, 1929. Patient had one child of 7 years and one miscarriage in 1924. She had a spontaneous abortion in July at which time she was about 3 months pregnant. The patient was a dehydrated colored female, fairly well developed and fairly well nourished, whose heart and lungs were negative. The abdomen was spastic and there was tenderness over the entire lower abdomen. Pelvic examination revealed a

marital outlet, the cervix small, posterior fixed with tenderness on manipulation. Uterus was immovable. There was a large fluctuant mass with tenderness on the right. Laboratory findings revealed a negative urine, white blood corpuscles 13,800, red blood corpuscles 4,000,000, hemoglobin 80 per cent, Wassermann 4 plus. On admission the temperature was 38.5 degrees C. The following day an extraperitoneal drainage of an abscess on the right broad ligament was done. Temperature was normal and the patient was comfortable on the fourth day after operation but the sinus continued to drain. Five per cent mercuric chrome was instilled into the abscess cavity daily and drainage gradually stopped. She was allowed up and this did not cause elevation of temperature. At the time of discharge the incision in the right side was surrounded by granulation tissue. There was a small sinus extending into the cavity. The cervix was pulled slightly to the right, the uterus anterior and pulled to the right. There was thickening but no definite mass in the right fornix. Diagnosis: broad ligament abscess, right syphilis (Wassermann).

CASE 4. G. M. aged 22 years, was admitted to the hospital September 28, 1929 and was discharged October 15, 1929. The patient, a married white female, was admitted through the dispensary with the complaint of lower abdominal pain and foul vaginal discharge. She had an abortion induced on September 2 after one missed period. There was such profuse bleeding, that she was taken to another

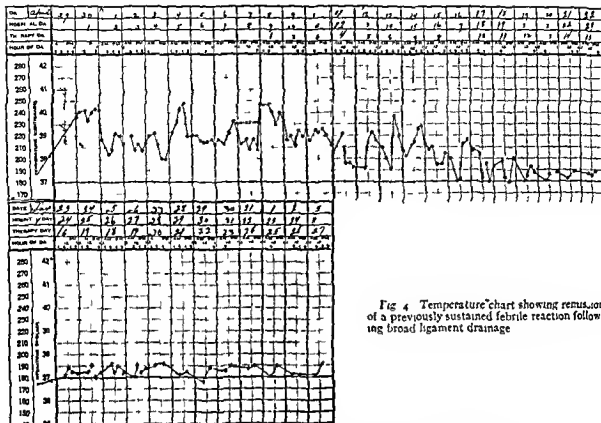


Fig 4. Temperature chart showing remission of a previously sustained febrile reaction following broad ligament drainage

palpation revealed no tenderness. White blood cell count was 9100. Diagnosis pelvic cellulitis. The patient was discharged on January 21, 1929, in good condition.

CASE 6. I. M. aged 32 years was admitted to the hospital June 7, 1929, and discharged September 25, 1929. The patient complained of pain in the abdomen, chills, fever, nausea, and vomiting. The patient was 4 months pregnant and on March 30, an induced abortion had been performed. She began to bleed 3 days later and continued to flow for 3 weeks. Ten days after the abortion she began to have chills and fever and was taken to a hospital where she remained for 3 weeks and was discharged improved. Menstrual periods began at the age of 12 years, were regular every 28 days lasting 2 to 3 days. The patient has had 2 children and 2 miscarriages. Heart and lungs were negative on examination. There was a board like rigidity over the entire abdomen with a definite palpable mass in the right lower quadrant. Pelvic examination revealed a normal outlet, the cervix anterior, large bilateral pelvic masses the one on the left extending above the umbilicus and beyond the midline to the right, filling the entire lower left quadrant. The one on the right was smaller and about the size of an orange. The uterus could not be definitely made out but it was thought to be posteriorly. The urine examination showed an albumin trace and pus in clumps. White blood cells numbered 34,000, red blood cells 3,200, 000 hemoglobin 58 per cent. Sedimentation time was 20 minutes. Wassermann was 3 plus. After she entered the hospital the temperature continued to rise and on the fifth day, extraperitoneal incision with drainage of the abscess was done. The temperature fell somewhat and the drains gradually were moved although the temperature continued

to rise occasionally to 39.5 degrees. On the twenty fourth day the sinus was again opened for better drainage and the temperature started a gradual downward course until the sixty sixth day when the abscess cavity was again explored. A large amount of pus escaped at each operation. The temperature fell almost to normal. Twelve days following this a transfusion was given of 500 cubic centimeters. On the one hundred and first day the temperature reached normal to remain there for the first time. Ten days later she was discharged from the hospital. During the stay in the hospital she was given neosalvarsan at weekly intervals. Improvement was gradual with occasional exacerbations from time of admission to time of discharge. Blood cultures were negative. Cultures from the broad ligament abscess showed a mixed infection, dominantly staphylococcus and colon bacillus. At the time of discharge the uterus was anterior and somewhat fixed. There was a slight amount of discharge from the incision. Diagnosis pelvic cellulitis bilateral and syphilis (Wassermann).

CASE 7. F. B. aged 36 years was admitted to the hospital February 4, 1929, and discharged March 12, 1929. The patient was a negro 36 years of age, 1 para the child being 4 years old. The patient came into the hospital complaining of uterine hemorrhage for 2 weeks. She had had nausea and vomiting for the past 2 weeks and severe cramp like pains in the lower abdomen. The patient menstruated normally in January. Past history was negative except for appendectomy and removal of a tubal pregnancy 4 years ago. Family history was negative. The temperature rose rapidly to 40.5 degrees C, declining to a level of 39 degrees C, where it remained for 8 days. Physical examination was essentially negative. Examination on admission revealed

SUMMARY

The clinical course of patients operated upon for parametric exudates, even during the period of firm infiltration, has led us to believe that the extraperitoneal placing of drains away from exudates in this region shortens the convalescence and definitely lessens the morbidity when compared with patients treated expectantly by position, rest, heat, only. These patients are infinitely more comfortable after incision and the placement of a drain down to the base of the broad ligament even though only a small amount of fluid or pus is evacuated at the time of incision. The deferment following incision, as may be seen from several typical temperature charts (Figs. 2, 3, 4, and 5), occurs by a gradual decline through the course of a number of days or occurs abruptly, sometimes several days after incision. The immediate effect of the drainage may be a transient

exacerbation of the febrile reaction of the patient as is frequently true following any operative procedure in a region of inflammation. This series of cases has been followed since operation and the postoperative condition of all is satisfactory.

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 Note: We wish to thank Miss Theodora Bergsland the artist of the Department of Surgery for the excellent illustrations and Benjamin J. Brownlow, photographer of the Lakeside Hospital.

ANEURISM OF THE PULMONARY ARTERY

H. R. WAHL, M.D., AND RAYMOND L. GARD, M.D., KANSAS CITY, KANSAS

From the Department of Pathology, University of Kansas School of Medicine, Kansas City, Kansas

WHILE true aneurisms of the pulmonary artery are rare as compared with those of the aorta, they do occur with sufficient frequency to be considered in the differential diagnosis of tumors of the mediastinum. The subject of pulmonary aneurism receives scant attention in the literature and is not discussed by the majority of textbooks. Aschoff and Kaufmann merely mention its rarity. Hirschfelder very briefly reviews Henschen's article. Henschen, in 1906, thoroughly searched the literature and compiled 46 cases of aneurism involving some portion of the pulmonary trunk or its two main branches. He discussed these cases from various viewpoints and attempted to explain their etiology. In 1909 Posselt discussed Henschen's work and added 9 new cases. The aneurisms of the smaller pulmonary branches associated with tuberculous cavitation of the lung and the mycotic or infectious embolic aneurisms described by Eppinger, are not uncommon. These, however, are not considered to be true pulmonary aneurisms.

It is our purpose in this paper to report an unusual case of pulmonary aneurism and to collect the cases reported since the work of Posselt in 1909. This case was observed during a period of 3 years, was studied with the X-ray and the electrocardiograph, and its surgical removal was attempted, the attempt ending in the death of the patient.

B. U., a white female student 19 years of age, was admitted to the Bell Memorial Hospital May 14, 1926, with the complaint of hoarseness, partial aphonia and dyspnea. From the patient's mother it was learned that at the age of 3 days the patient was short of breath and at times was "blue." During early childhood she was able to run and play as other children but when 7 years old she began to be dyspneic on exertion. At the ages of 11 and 17 she had influenza following which her dyspnea became more severe, forcing her to leave school. At the same time increasing hoarseness developed. For the past 3 years she has expectorated, at intervals, small amounts of rusty colored sputum and at one time a small quantity of red blood. For the past 2 years she has complained of indefinite dull pain in the substernal region. Her activities have gradually decreased so that at the time of her admission to the hospital she was able to do only the lightest tasks about her home. There was no history of rheumatic fever, tonsillitis, chorea, scarlet fever or venereal disease.

Physical examination showed a well developed girl of 19, breathing with some difficulty at the rate of 24 a minute. Her face and neck were flushed and her lips were purplish red. The veins of her neck were distended and pulsating. The pupils were dilated, equal, and reacted to light and accommodation. The conjunctiva and retinal vessels were congested. The ears, nose, and throat were negative. The

thyroid was not palpable. The chest was well formed but there was a distinct bulging of the manubrial area, greatest on the right side at the level of the third rib. Pressure over this elevated area elicited slight dull pain. Tactile and vocal fremitus were normal. The breath sounds over the entire chest were harsh. D'Espines sign was positive. The relative cardiac dullness measures 4 centimeters to the right and 12 centimeters to the left. The first pulmonic sound was thudding and the second greatly accentuated. After exercise there was a pre systolic thrill and rumble at the apex. The radial pulses were small, equal, regular, and varied from 78 to 100 per minute. There was a diastolic murmur at the apex and along the left sternal border. The blood pressure in each brachial artery was the same, 110 millimeters mercury systolic and 80 diastolic. The abdomen was normal in contour, the liver palpable and slightly tender. There was no edema of the extremities. The finger nails were cyanotic and there was slight clubbing of the finger tips. The deep reflexes were slightly exaggerated. Laryngoscopic examination showed an abductor and adductor paralysis of the left vocal cord.

X-ray examination (Fig. 1A) showed a 30 per cent enlargement of the left heart shadow, including the aorta. In addition there was a rounded mass lying in the region of the aortic arch on the left side and another triangular area of similar density projecting outward from the right hilus shadow. (Fluoroscopic examination showed no pulsation of these tumor masses.)

Examination of the urine showed nothing abnormal. Red blood cell count was 4,300,000, hemoglobin (by Sahli) was 90 per cent and the white count numbered 19,600, with a normal differential count.

The Wassermann reaction was negative.

The clinical diagnosis made was mitral stenosis, mediastinal tumor and paralysis of the left recurrent laryngeal nerve. Along with symptomatic treatment the patient was given deep X-ray therapy to the mediastinal masses.

An electrocardiographic tracing (Fig. 2) showed an increase in the magnitude and a definite right sided cardiac hypertrophy. Four weeks following the X-ray treatments another plate (Fig. 1A) showed no change in the size of the tumor masses but they had a more definite outline and their shadow was denser.

Two months later the patient was again admitted and showed no essential change in the physical signs. An X-ray of the chest showed little change (Fig. 1B). Patient was given another course of X-ray therapy and dismissed.

On November 10, 1926, the patient was again admitted complaining of increasing hoarseness, dyspnea and some palpitation and cough. The physical findings were unchanged. The X-ray examination showed a slight increase in the size and considerable increase in the density of the tumor masses (Fig. 1C).

Twenty seven months later (part of which time she had spent in a high altitude with considerable symptomatic relief) the patient was again admitted and showed a definite increase in hoarseness, slightly more dyspnea, and an increase in the cyanosis. At this time her fingers and part of her hands were bluish and the finger tips definitely clubbed. The bulging of the manubrial area was increased and the patient complained of a more distressing, dull aching in the chest beneath this area. She had had two attacks of hæmoptysis each lasting about an hour but with little loss of blood. There had been a constant, irritating cough with

only a little rust colored sputum. The X-ray examination at this time showed the tumor masses to be slightly increased in size and density (Fig. 1D). The red blood count was 6,000,000 and the hemoglobin 120 per cent.

It was believed that the mediastinal masses were some kind of benign tumor, possibly dermoid cysts, and following the patient's repeated request an attempt at their removal was made. A posterior incision was made along the seventh rib to the midaxillary line and a portion of the seventh rib was removed. An extrapleural dissection was done and a firm tumor mass easily exposed. The capsule of the tumor was incised and an attempt made to enucleate its content which appeared to consist of grayish brown, cellular material. After a small amount of this material had been removed there was a sudden and fatal gush of blood.

The autopsy performed within an hour after death was limited to the removal of the heart through the surgical incision. The heart with proximal portion of the aorta and pulmonary artery weighed 623 grams and showed a definite right sided hypertrophy (Fig. 3). It measured 11 centimeters from base to apex, 11 centimeters across the base and 7 centimeters anteroposteriorly. The pericardium was smooth and glistening. The myocardium of the right ventricle measured 20 to 35 millimeters in thickness while that of the left ventricle 10 to 15 millimeters. The muscle was firm in consistency, dark reddish brown in color and showed a little yellowish mottling in the papillary muscles. The circumferences of the valve rings were as follows: tricuspid 9.5 centimeters, mitral 4.5 centimeters, pulmonary 8 centimeters and aortic 4 centimeters. The foramen ovale was wide open, measured 22 millimeters in diameter, almost forming a cor trioculare. The aorta measures 1.6 centimeters in diameter and had thin, soft pliable walls similar to that of a child of 10 years. The pulmonary trunk and the two main branches up to the point where they enter the lung tissue were greatly dilated, and were completely filled with laminated grayish brown thrombotic material which showed some organization of the layers next to the arterial wall. The trunk measured 4.3 centimeters in diameter. The left branch appeared as a rough spheroidal mass and measured 7 centimeters in diameter. The right branch was roughly cylindrical and measured 4 centimeters in diameter. The smaller branches were not dilated and arose abruptly from the distended portion and measured 3 to 6 millimeters in diameter. They were flattened out over the thrombotic aneurysmal mass. The large veins from the neck and upper mediastinum were also flattened over the mass as they approached the heart. The ductus Botalli appeared as a slender fibrous cord and its lumen was entirely occluded. The smaller branches of the pulmonary artery showed numerous yellowish white, elevated diffuse thickenings of the intima.

Histological section of the heart muscle showed fragmentation, segmentation, some granular degeneration and slight lymphocytic and plasma cell infiltration with a patchy increase in stroma. Section of the aorta showed a thickened intima which was indefinitely outlined from the media. There was slight calcification in the intima. In the media there was some wrinkling and slight perivascular infiltration of plasma cells and lymphocytes. Attached to the intima of the pulmonary artery there was a dense mass of hyalinized material showing numerous young fibroblasts and other evidence of the partial organization of the thrombotic aneurysm. The wall of the pulmonary artery was markedly thickened, mostly in the media and adventitia. In the media and adventitia there was considerable wrinkling and distortion of the elastic fibers. Section stained with Verhoeff's elastic tissue stain showed the scarcity and in places the absence of these fibers with their replacement

by hyalinized cicatricial fibrous tissue. About the vasa vasorum of the adventitia and media there was considerable perivascular lymphocytic and plasma cell infiltration with swelling of the endothelial cells (Fig. 4). The orderly parallel arrangement of the elastic fibers was broken up and distorted by the round cell infiltration producing a wrinkled, scarred inflammatory appearance suggesting a syphilitic arteritis. Section of the small pulmonary arteries showed in the adventitia and media a typical perivascular lymphocytic and plasma cell infiltration with swollen endothelial cells, distortion of the adjacent elastic fibers and secondary atheromatous changes in the media and intima (Fig. 5). The atheromatous areas contain material readily stained with Scharlach R. Levaditi preparations were negative for spirochæta pallida.

In the light of the autopsy findings the clinical symptoms can be readily explained. The association between the dyspnoea and cyanosis of infancy and childhood with the widely patent foramen ovale is obvious. The vocal cord paralysis was undoubtedly due to the pressure of the thrombotic aneurism upon the left recurrent laryngeal nerve as it passes under the arch of the aorta. Pressure from the slowly growing aneurism partly collapsed the superior vena cava producing congestion and cyanosis of the hands, face, and neck. The almost complete thrombosis of the pulmonary trunk and branches increased the pressure and accounts for the marked right sided cardiac hypertrophy and the greatly accentuated second pulmonic sound. The non pulsating bulging of the manubrial area was a direct result of the gradual increase in size of the aneurism and its thrombosis.

The clinical diagnosis of pulmonary aneurism is very difficult there being only one case reported in which an antemortem diagnosis proved by autopsy has been made. Henschen believes that the diagnosis of pulmonary aneurism can be made when the following signs are simultaneously present:

- 1 Prominence of the second and third left costal cartilage with well defined dullness and X-ray shadow in this area.
- 2 Intense cyanosis, other signs of congestion, hæmoptysis and substernal pain.
- 3 Pulsation and well defined thrill and murmur in the second left interspace.
- 4 Loud superficial rasping systolic murmur.
- 5 Right sided cardiac hypertrophy.
- 6 Absence of dilatation or hypertrophy of the left heart (i.e., apex dullness within the mid-clavicular line).
- 7 Absence of usual signs of aortic aneurism (viz., dullness to right, difference in pulse, recurrent laryngeal paralysis).

In our case the first, second, and fifth signs were present. The third sign was entirely absent.



Fig 1 A, Roentgenogram of heart showing cardiac hypertrophy with indefinitely outlined masses in right and left mediastinum B C D Roentgenograms taken at different intervals showing gradual increase in density of the masses due appa ently to increasing amounts of thrombotic material in the aneurismal sac

due to the almost complete thrombosis of the entire trunk and bronchus. The fourth sign was altered, the murmur being presystolic and rumbling in character, accompanied by a thrill and possibly due to the very widely patent foramen ovale. The sixth sign was indefinite because although the left heart actually was not hypertrophied the X-ray shadow and the findings by percussion strongly suggested a definite left sided hypertrophy. The seventh sign was of minor importance for the patient had a number of the important findings of aortic aneurism, such as substernal pain and oppression, dyspnoea, cough (though not "brassy" in character), palpitation, hoarseness and a visible tumor.

Fourteen cases verified by postmortem examination have been collected from the literature since Posselt published 9 additional ones in 1909. They are briefly abstracted as follows.

CASE 1. Reported by Reiche. Male, aged 17 years had actinomycosis of the chest and mediastinum with draining sinuses, with continuous, loud, diastolic systolic murmur at the base. Autopsy showed sacular aneurism the size of a cherry seed located on the posterior surface of the artery near its bifurcation.

CASE 2. Reported by Barth. Male, aged 57 years. Six years before had a "stroke". Autopsy showed pulmonary aneurism, right sided cardiac hypertrophy. Wall of aneurism and pulmonary artery showed histological picture similar to a syphilitic aortitis.

CASE 3. Reported by A. Ploeger. Woman, aged 52 years, had had cardiac pain for 22 years associated with

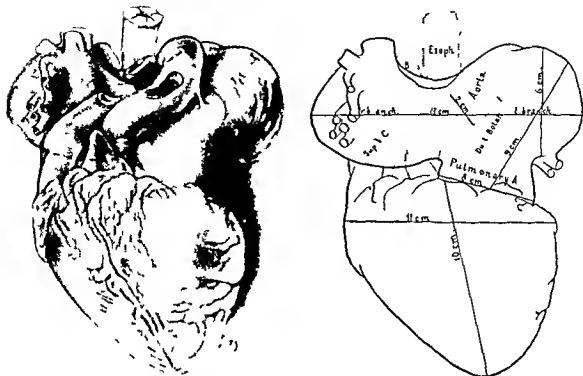


Fig 2 Drawing of heart and aneurism of the pulmonary artery showing its relations and size (reduced 1/2)

cyanosis and dyspnea. Loud systolic murmur was present over mitral area. Pulse irregular. hyaline casts in urine. fingers clubbed. X ray film showed dilated shadow in pulmonary area. Varicose veins and edema were noted in both lower extremities with an old hyperplastic periostitis near the malleolus. Autopsy revealed extensive sclerosis of the pulmonary artery and enlarged heart especially in the right. atherosclerosis of aorta. chronic ulcerative tuberculosis of upper left lobe. gall stones. dermoid cyst of right ovary. old cystic hemorrhage of the brain and a large sacular aneurism of the pulmonary artery partly occluded by a thrombus. The wall showed a typical perivascular inflammatory reaction characteristic of lues. No such reaction was seen in the aorta. Author considered aneurism to be luetic in origin.

CASE 4. Reported by Letulle and M. Jacquelin. Male aged 58 years entered hospital 20 hours before death. He had had dyspnea, cardiac arrhythmia, cyanosis and general edema. The heart was large and dilated. No history of lues was given, but history of rheumatism. The cyanosis was out of proportion to the condition of the heart and lung. He died suddenly. Autopsy revealed a fusiform aneurism of the right pulmonary artery with its lumen largely occluded by a laminated clot. The ductus Botalli was closed and the right ventricle was hypertrophied and dilated. The wall of the arteries and of aneurism showed a perivascular reaction suggesting a luetic reaction.

CASE 5. Reported by Marble and White. Male aged 25 years lieutenant had a gunshot wound of the right chest. Abnormal dullness to percussion was noted on right side. Loud systolic diastolic murmur present at apex.

X ray examination showed dense spherical shadow at the base of the right lung. Numerous pulmonary hemorrhages preceded death 5 months after wound. Autopsy showed aneurism of the right pulmonary branch, the size of an orange, located 4 centimeters distal to the bifurcation of the trunk. A large valve like opening connected with a bronchus.

CASE 6. Reported by Foster. Male aged 25 years had preceordial pain, cough, dyspnea and dysphagia with cyanosis. Definite visible and palpable pulsation were noted over the upper sternum. Analysis of one vocal cord present. Fluoroscope showed pulsating tumor in upper mediastinum. Wassermann was strongly positive. Patient had pneumonia. Autopsy showed aneurism of the pulmonary artery.

CASE 7. Reported by Blechman and Paulin. Infant had a funnel shaped aneurismal dilatation of the pulmonary trunk, the larger part being at the ostium. There was a congenital interventricular opening. Ulcerative pneumococcal endocarditis.

CASE 8. Reported by Sutherland. Female aged 4 years had progressive cardiac failure with edema of lungs, dyspnea and cyanosis. Autopsy showed aneurismal dilatation of the pulmonary trunk and left branch beginning 1/4 inch from the pulmonary ostium and extending to the lung. The aneurism measured 3.8 centimeters in diameter and throughout its entire length was occluded by a firm thrombotic mass. The ductus arteriosus was a thin fibrous cord.

There were other congenital anomalies. There was a supernumerary toe, the fourth and fifth digits were fused and the fifth finger had a double nail.

CASE 9. Reported by Arrillaga. Male, aged 40 years gave a history of hæmoptysis, cyanosis, dyspnoea and neck vessels unusually congested. X-ray examination showed a dilatation of pulmonary artery. Pulmonic second sound was accentuated. Wassermann was strongly positive. Autopsy revealed sclerosis of the pulmonary artery with aneurismal dilatation of the trunk.

CASE 10. Reported by Arrillaga. Male, 38 years, with history of weakness, oedema and cyanosis, had the right ventricle enlarged. Rales were heard over both bases. Systolic murmur at the apex. Wassermann was negative. Autopsy showed an aneurism of the pulmonary artery with rupture into the pericardial cavity. Atheromatous plaques were abundant in the wall of the aneurism.

CASE 11. Reported by Arrillaga. Patient gave a history of dyspnoea, oedema, and cyanosis, especially of head and neck. X-ray examination showed a dilated right heart and dilatation of the pulmonary artery. Second pulmonic sounds were accentuated. The autopsy showed arterio-sclerosis of the pulmonary artery with a saccular aneurism of left branch of pulmonary artery. Macroscopic appearance suggested lues. Treponema was demonstrated in the lungs and in the walls of the pulmonary artery.

CASE 12. Reported by Moench. Female, aged 29 years, housewife, had dyspnoea and vertigo. Death occurred suddenly. She had always been well and had worked hard. There was an aneurismal dilatation of the pulmonary trunk measuring 7.6 centimeters in diameter with linear rupture on the anterior surface and the pericardial sac was distended with fresh blood. The ductus Botalli was patent easily admitting the index finger. The mitral valve was thickened and the aorta showed a few atheromatous plaques.

CASE 13. Reported by Poinso. Female, aged 35 years, had precordial pain, dyspnoea, and cyanosis. The Wassermann was 2 plus. Autopsy showed cylindrical dilatation of the trunk with thrombosis and partial canalization. Microscopic examination showed arteritis with military gummata about the vasa vasorum, and fragmentation of many of the elastic fibers.

CASE 14. Reported by Warthin. Male, aged 37 years, had chancre 28 years ago, frequent pulmonary hemorrhages, hoarseness, cough. The point of maximum cardiac impulse was outside the nipple line. Diastolic murmur was in third intercostal space transmitted upward. Wassermann 4 plus. X-ray diagnosis was neoplasm. Autopsy revealed the aortic arch dilated and showed luetic aortitis. An aneurism of branch of pulmonary artery, size of guinea hen's egg was filled with laminated blood clot, the wall showing the gross appearance of syphilitic arteritis, hepatitis with multiple gummata.

The etiology of pulmonary aneurism is not definitely established and it is probable that no one factor will explain them all. Henschen believes that syphilis is the most frequent and important agent and cites 12 cases in which syphilitic lesions were found (macroscopically). Because but few of his cases were accompanied by histological pictures, the true incidence of syphilis may have been considerably higher. Posselt says that, while it is true syphilis is an important factor in producing pulmonary aneurism, it must be remembered that atheromatous changes also cause the condition and thinks this process is probably the basic and essential role. He considers that atheromatous changes begin in the smaller pul-

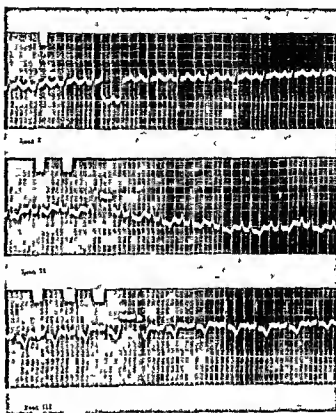


Fig. 3. Electrocardiogram showing right sided preponderance and increased magnitude of deflection.

monary branches as well as in the trunk and the consequent reduction in the lumina of the pulmonary tree increased the blood pressure which causes a dilatation in the already diseased vessel wall. Peck has shown that syphilis of the pulmonary vessels is a rare finding, only 29 undoubted cases in the international literature and only 3 cases of syphilitic pulmonary aneurism which macroscopically and microscopically gave pictures comparable to aortic syphilis. Warthin has reported a case of pulmonary aneurism and has demonstrated the spirochæta pallida in the wall of the aneurism near the adventitia. Poinso's case showed military gummata.

Sex has apparently little etiological significance, only a few more cases being found in the female than in the male.

About 40 per cent of the cases occur under 30 years of age. This is in distinct contrast with aortic aneurisms in which only 18 per cent occur under 30 years (Hirshfelder).

Congenital malformations of the heart unquestionably play a part in the etiology of pulmonary aneurisms. The most frequently occurring type of malformation is the patent ductus Botalli—8 of Henschen's cases and one of Posselt's cases showing this. Moench reported a case in which the ductus Botalli would easily admit one's index

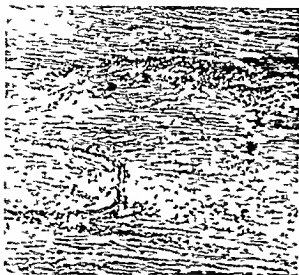


Fig. 4. Section of wall of pulmonary artery showing perivascular inflammatory reaction and scarring in the media ($\times 100$) similar to characteristic lesions in luetic mesoarteritis.



Fig. 5. Section through branches of pulmonary artery showing typical perivascular inflammatory reaction with atheromatous change ($\times 83$).

finger, and he thinks congenital cardiopathy is probably the essential factor in the etiology. However, many patent ducti Botalli unassociated with pulmonary aneurism and vice versa are seen. The association of pulmonary aneurism with aortic stenosis, pulmonary stenosis, patent foramen ovale, aplasia of aorta or pulmonary trunk, is also frequently noted among the reported cases. Blechman and Paulin's case had a patent inter-ventricular septum. The frequency of the association of malformations of the heart with pulmonary aneurisms may have its explanation in the fact that in such congenital hearts greater strain is thrown upon the pulmonary aorta than the systemic aorta, and if there is an underlying arteritis (usually luetic) the wall would be weakened and a gradual dilatation ensue.

Endocarditis and pericarditis are probably unrelated or secondary rather than causal.

Trauma has been an etiological factor in two cases: Konietzky and Marble and White.

In our case there was no history or stigmata of syphilis, the Wassermann reaction was negative, and we were not able to demonstrate the spirocheta pallida with Levaditi preparation. The histological picture, however, of the pulmonary trunk wall, the wall of the aneurism and of the smaller pulmonary branches was exactly comparable to that so frequently seen in syphilitic arteritis and the aorta. Lymphocytic and plasma cell perivascular infiltration with endothelial re-

action, fragmentation, distortion and cicatrization of the elastic fibers along with the secondary atheromatous change leads us to think of this process as probably syphilitic in character. This patient's clinical course and mistake in diagnosis illustrates the importance of considering pulmonary aneurism in the differentiation of obscure mediastinal masses.

SUMMARY

This is a detailed report of a typical aneurism of the pulmonary artery in a young woman. It was opened by mistake, having been considered a solid mediastinal mass, and resulted in fatal hemorrhage. There is also a brief summary of 14 new cases confirmed by autopsy to be added to those described by Henschen in 1905 and Posselt in 1911, making a total of 70 cases in the literature.

These aneurisms are usually associated with some congenital anomaly of the heart and often have a syphilitic base. They have been reported most frequently in relatively early adult life. Their occurrence is sufficiently frequent to emphasize their consideration in the diagnosis of mediastinal masses.

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NOTE.—We wish to express our appreciation to Dr T G Orr for the use of his records on this patient

POLYPS OF THE LARGE INTESTINE¹

GRATTAN FITZGIBBON M.D. ROCHESTER MINNESOTA

Fellow in Surgery The Mayo Foundation

AND

IRID W. RANKIN M.D. F.A.C.S. ROCHESTER, MINNESOTA

Division of Surgery The Mayo Clinic

IN the attack on carcinoma the conviction is deepening that little is to be gained from the further study of the histological picture of full grown carcinoma, and that there is more promise in the field of possible precancerous formations. Carcinoma appears practically eight times as often in the sigmoid and rectum as it does elsewhere in the colon, and polyps of the large intestine maintain in their growth approximately this same ratio of distribution. The sigmoid and rectum are thus the commonest sites for both forms of new growth, a fact that at once points to a suspicious relationship between them.

In the aggressive surgery of the day, removal of a malignant growth in the sigmoid or rectum ordinarily is accomplished by resection with it of long reaches of the lower part of the colon. It is this practice that brings to the pathologist not only matured carcinomata but also areas of the sigmoidal and rectal mucosa exceeded only by the skin and its appendages in extent of available sites for the study of precancerous changes. Accordingly, it is to these resected specimens of the polyp-bearing mucosa of the colon that this work is addressed. We propose in this study (1) to review the histopathology of polyps (2) to show that they are not all of a piece and that under the name are included definitely precancerous formations,

and (3) to trace from such formations the growth of numerous outright and deep seated carcinomata of the large intestine.

In the reports of cases, only autonomous new growths, true blastomata of the intestinal mucous membrane not yet clear cut carcinoma, are considered under the term polyp. This restricted use of the word calls for arbitrary exclusion of the polypoid formations seen in hyperplastic tuberculosis, and so often at the edges of ulcers in ulcerative colitis and in the regenerated mucosa of colons constricted by the latter disease. These inflammatory epithelial proliferations have come to be widely enough recognized as the possible precursors of cancerous change to entitle them to separate consideration and direct attack.

In the literature that has grown up around the study of polyps of the large intestine, various classifications of the growths have been proposed some based on supposed etiological factors, others on the clinical manifestations of the tumors, and still others on their internal histological structure. Nearly 40 years ago, Hauser, excluding all formations having a possible inflammatory background, argued that polyps could be grouped according to the amount of degenerated epithelium within them. Wechselmann, in 1909 devised a three phase classification but, like Hauser, limited his critical analyses to the epithelial elements of the tumors. Schmieden and Westhaus in 1927, by introducing consideration of selected attributes of the connective tissue framework, pedicle formations, and macroscopic appearance, rendered the Wechselmann criteria much more useful. These latter authors stressed in particular precancerous changes in polyps.

THE PATHOLOGICAL ANATOMY OF POLYPS

We shall attempt here to continue the work of establishing for polyps a histological classification. On examining the tumors it can be seen that they fall readily into three major histological divisions as follows:

Polyps of group 1 In this group are included only those growths in which the epithelium retains its normal characteristics. The tumors are usually roughly nodular, although in some of the speci-



Fig. 1. Polyp of group 1. Nodular pedunculated tumor. The epithelium of its surface and crypts remains entirely normal. Nuclear activity in the loose arcolar stroma is at a minimum.

¹Abridgment of thesis submitted by Dr. Fitzgibbon to the faculty of the Graduate School of the University of Minnesota in partial fulfillment for the degree of Master of Science in Surgery, 1919.

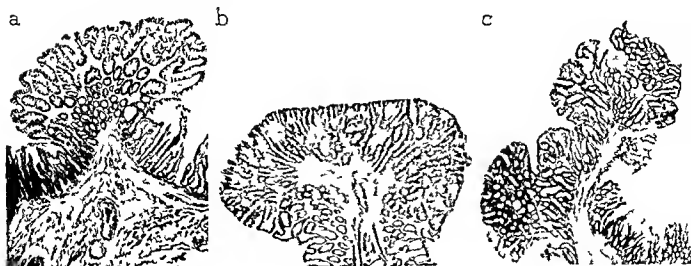


Fig 2

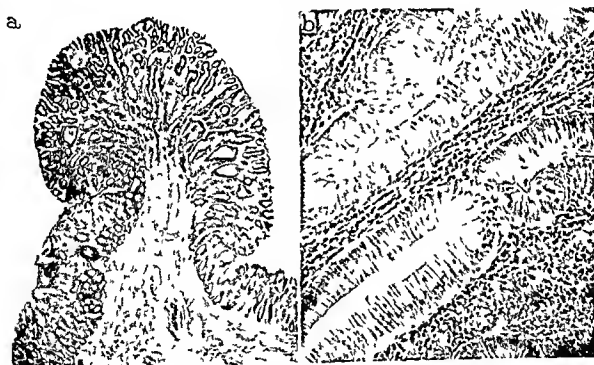


Fig 3

Fig 2 Early growth of polyps of group 2. a, Tiny bud of enlarged and deformed glandular tubules. The tug of the proliferation on the submucosa is already apparent. b, Drift of connective tissue is to left side of the tumor where darker, more active proliferation is in progress. c, Mature polyp (6 millimeter). There are two dark areas of active proliferation still within it.

Fig 3 Early polyp of group 2. a, Extremely active polyp, 3 millimeters in diameter, at an early stage of

development. The proliferative, dark staining polyp epithelium contrasts sharply with the normal mucosa from which it springs. b, Characteristic polyp epithelium. The sector of the tubule at the bottom of the picture contains normal goblet cells. In the center is seen an intermediate stage in the development of the true polyp epithelium appearing in the upper tubule, a tubule formed by elongated compressed, multilayered cells with dark staining, rod shaped nuclei.

mens the surface is smooth and regular. Although the epithelium covering the growth and lining its crypts is unchanged from the standard regarded as normal, nevertheless there may be in scattered areas some evidence of slight hyperplasia. Such areas are the sites of more or less active inflam-

mation secondary to the constant trauma to which the tumors in their exposed positions are constantly subjected. Polyps of this group vary in size from tiny clubs about 3 millimeters in diameter to masses 1 or 2 centimeters in cross section (Fig 1). Loose connective tissue derived from the



Fig 4 a Enlargement of area marked A in Figure 4 b the site of a microscopic (2 millimeters) adenocarcinoma graded 2 b Long stemmed aged polyp of group 2 from splenic flexure of colon resected for generalized polyposis Case 1

submucosa forms the matrix of the stalk and expands to sustain the nodular polyp. There is no tendency in growths of group 1 to branching or papillary forms.

Polyps of group 1 are invariably pedunculated. Even in the smallest tumors of this group encountered in our specimens there is evidence of formation of a stalk. The pedicles are usually cylindrical structures of variable lengths up to 6 centimeters or more, composed of connective tissue derived from the submucosa and covered with normal appearing mucous membrane. Sometimes, in the heavier tumors, the pedicle becomes flattened into a ribbon like strip. In polyps of this group, it is thought that the formation of the pedicle is due purely to mechanical factors arising outside of the tumor itself. As the little knob proceeds into the lumen of the intestine, it is played on by the forces of peristaltic action and the current of the intestinal content, and so pulled out that a stalk more or less attenuated is produced.

It must be recognized that peristalsis, evoked in the intestinal musculature by the irritation of what is virtually a foreign body, can attain in this region great force. Instances are recorded in which polyps of this type have been amputated from the tips of their pedicles not by ulceration but by outright avulsion by peristaltic action. Then, too, numerous cases of intussusception have resulted from the peristaltic pull on the tumors. The patient from whom was taken the polyp shown in Figure 1, had to submit three times to operative intervention for the relief of acute intestinal obstruction. Each time, intussusception of some

degree was found, and each time a polyp of this type was at the bottom of the trouble.

It is conceivable that whatever initiates carcinomatous change in polyps could likewise find its expression in the epithelium of this group. There is, however, nothing about the tumors of group 1 to indicate that they are any more liable to malignant development than is normal intestinal mucous membrane. It can, therefore, be said that the polyps of group 1 are destined to a long and benign course. No such pronouncement can be made, however, for the polyps of group 2.

Polyps of group 2. The polyps of this group are easily distinguished from those of group 1 by the abrupt and striking structural changes in both the epithelium and in the connective tissue elements. The epithelium is characterized by widespread failure of the proliferating cells to differentiate completely into the units of normal intestinal mucosa. In the polyp epithelium the cells are hypertrophied, elongated, and by their increased bulk compressed from side to side. They may stay arranged in single rows, but in numerous places the press of overgrowth piles them into multilayered buds that project usually into the lumens of tubules and frequently into the connective tissue matrix as well. The nuclei, like the cells, are elongated. They are stained more deeply by all the routinely used dyes and thus give to the proliferation a darker and easily recognized color. In the cellular protoplasm, the production of mucus is sharply diminished.

These epithelial changes do not appear equally advanced over the whole of the group. Usually there is a peripheral dark zone of greater cellular

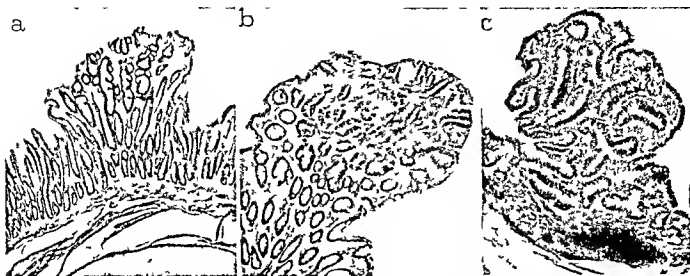


Fig 5 The growth of polyps of group 3 a, Sprout of enlarged tubules lined by typical polyp epithelium initiating the growth b, Continued proliferation of polyp epithelium No evidence of stalk formation such as occurs in group 2 can be seen c, The polyp epithelium has completely suppressed the growth of normal tubules and has already reached the muscularis mucosae

activity where this changed epithelium will first be found, particularly in the early forms of this group As the polyp ages, the changed epithelium will have displaced entirely the more differentiated structure which it has infiltrated, overgrown, and choked

The peripheral dark zone so characteristic of growing polyps is composed almost entirely of complexes of glandular tubules These tubules, increased both in diameter and length by the hypertrophy of the component cells, crowd and press one another into a tangled mass One frequently finds cellular activity at its height at those points where the epithelium of the tubule debouches onto the surface of the tumor and spreads out over it to form its investing membrane In places one can see the tubules of the polyps projecting down between the more normal glands at the base of the tumor Nearly every polyp of this type reveals cystic enclosures which have been formed by the accumulation of secretion in the deformed and obstructed glands

As this process of epithelial proliferation goes on there is a complementary response in the connective tissues of the submucosa The tug of the tumor soon pulls the muscularis mucosae and some fibrils of the underlying looser areolar tissue upward to form a tiny stalk If the tempo of growth is not too brisk, the connective tissue elements are drawn out into ever-branching divisions which form a tree-like supporting scaffolding for the epithelial complexes At irregular places, however, in polyps of this group, the epithelium may grow out in long, tender tendrils that give to these areas a shaggy, papillary structure It is these tendrils



Fig 6 An entire colon removed *en masse* for generalized polyposis a Deeply penetrating adenocarcinoma graded 2 b Site of macroscopic adenocarcinoma graded 2, in a polyp of group 3 c, Massive polyp of group 2 in which are regions of adenocarcinoma, graded 1 d, Pedicle of a polyp of group 2 which became detached in handling but which is exactly similar to the one at c See also Figures 7 and 8 Case 1



Fig 7 Cross section of deeply penetrating adenocarcinoma graded 2 shown in figure 6a. Compare the low power enlargement (Fig 7b) of this carcinoma with one found arising in a nearby polyp of group 3 (Fig 8a) Case 1

that are readily injured by intestinal action and are thus the sources of the hemorrhages that so mark the course of these tumors

The polyps of group 2 are also invariably pedunculated. Two massive, egg sized tumors (6 by 4 centimeters) of this group in our specimens swung from pedicles fully 6 centimeters in length, a pattern which other and smaller polyps followed in their own ways. It is true that one frequently sees flattened, hemispherical excrescences set apparently in or on the intestinal mucosa like a plush or velvet covered button in overstuffed upholstery. These tumors are called sessile tumors. The overhanging edges of the growth have concealed the stalk. A cross section through the tumor will reveal the short, stubby pedicle and the true cauliflower structure of the polyp. Many of these sessile growths are, in fact, congeries of innumerable smaller growths, each organized in this cauliflower like fashion.

Polyps of group 2 usually show somewhere within them evidences of inflammatory processes, at least, areas are to be found actively infiltrated with round cells. These inflammatory reactions which appear in the tumor are ordinarily completely absent in the adjacent normal mucosa and can, therefore, be regarded as results of the inescapable trauma to which such growths exposed to the intestinal current must submit.

In the accompanying illustrations, the development of the polyps of group 2 can be traced from the earliest buds to matured proliferation. Figure 2a depicts a tiny bud of mucosal glands in which the tubules are already enlarged and deformed and in which the darkened polyp type

of epithelium makes its appearance. Even at this stage the tug of the proliferation is felt by the muscularis mucosae and the areolar tissues of the submucosa and a rudimentary stalk is being formed. In Figure 2b is shown evidence of the unequal proliferation in a growth slightly more advanced. It will be noted that the darker and more active area of the tumor lies to the left, and toward it there is an early drift of connective tissue branching. In Figure 2c in a pea sized (6 millimeter) polyp of this group, there are two areas of dark colored cellular activity on the periphery of the growing tumor.

The sharp contrast between true polyp epithelium, as described in the foregoing paragraphs, and the normal type of intestinal mucosa from which it springs is well shown in Figures 3a and 3b. This tumor does not cap a mucosal fold, as do so many of the proliferations. The growth was found on the broad side of a sigmoidal fold. The cellular activity in the tubules and the multilayered buds projecting into the lumen of the gland are plainly shown.

The polyps of group 2, with their connective tissue foundations laid out to follow a well considered plan of tree like formation, attain to the largest size in these tumors. All the large tumors of our specimens, and all the larger tumors of which there is adequate pathological description in the literature, fall at once into this group. This group then will embrace most of the polyp formations developing in the large intestine. That the growths are not, however, consistently benign, is well known. Figure 4 reveals the fate that so often overtakes these

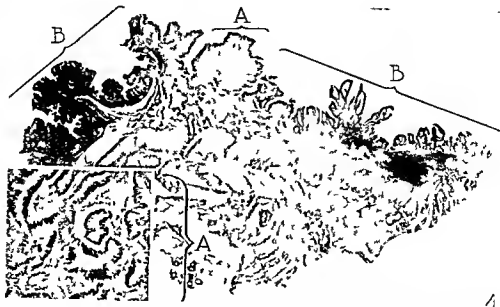


Fig 8 Tiny, microscopic areas of adenocarcinoma graded 2, arising in congeries of polyps of group 3. A, Adenocarcinoma graded 2. B, Polyps of group 3. Compare low power enlargement of this carcinoma (inset) with similar enlargement made of tissue of nearby deep seated adenocarcinoma graded 2 shown in Figure 7b. Case 1.

tumors The area of outright carcinoma (adenocarcinoma, graded 2), is microscopic in dimensions. Had not the section luckily gone through this tiny carcinoma, the character of the growth surely would have been misjudged. In fact, this particular polyp, like many others in the series, was sectioned as a routine and pronounced benign. How many of these tumors are mislabeled, no one can know. Certainly, it is out of the question, in every day laboratory practice, to submit all of them to serial sectioning.

It would seem that the development of carcinoma in polyps depends on the rate at which the tumor is driven to grow. In the slow paced formations of group 1 there is little, if any, likelihood of cancerous change. In the relatively more rapid growth of the polyps of group 2 it is a question only of time until carcinoma appears. Apparently, intestinal epithelium cannot proliferate indefinitely, even at a moderate rate, without ultimately losing its bearings. This matter of rate of development is strikingly illustrated in the polyps of group 3.

Polyps of group 3 In the polyps of this group, as in those of group 2, there has been failure of epithelium to differentiate. But in this group are only those tumors in the epithelium of which the processes of differentiation have been arrested at so early a stage that the cells have attained only the most rudimentary characteristics of the normal units of intestinal mucosa. There is thus no sharp line of separation between polyps of groups 2 and 3, as there is between polyps of

groups 1 and 2. Polyps of group 3 are but accented forms of the growths of group 2, in which cellular activity reaches its height for such tumors. And thus, too, there is formed a twilight zone into which may fall tumors bearing the characteristics of both groups. Although in this border zone there are not always clear-cut distinctions between polyps of the two groups, yet it is useful to maintain this three-phase classification. In the older polyps of group 3, the cellular changes are advanced and unmistakable, in the younger polyps, other and secondary features of the tumors help to identify them for grouping.

Polyps of group 3, like those of the other groups, must start in an overgrowth of glandular tubules in the mucosa. At first there is prolongation and enlargement of the tubules. These regions of incipient proliferation are so small that they will escape observation unless they are sought for with a sufficiently powerful lens. Certain authors, endeavoring to show that polyps are the result of primary injury inflicted on the intestinal mucosa at points of increased friction, and on the flexures and the mucosal folds, maintain that these early proliferations are situated on the tops of the folds, where secondary traumatic inflammatory reaction would most commonly occur. We found the sites of these tiny growths to be not so much on the tops of the folds as scattered haphazard over the mucous membrane. The little growth shown in Figure 5a was taken from the trough, and not the

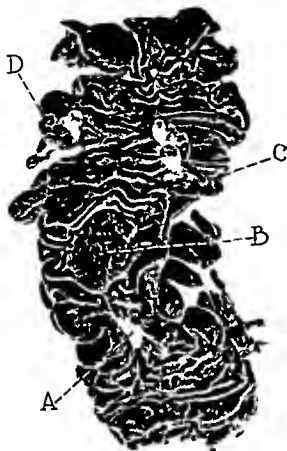


Fig 9. Specimen from rectosigmoid. 1 Adenocarcinoma graded 2. B Adenocarcinoma graded 2. C and D Polyps of group 2 extensively involved in adenocarcinoma, graded 2. See also Figures 10 and 11. Case 2.

crest, of one of these folds. The slightly more advanced growth in Figure 5b occurred on the stalk of a polyp of group 2. In Figure 5c, however, is a proliferation of group 3 taken from the height of a fold.

Polyps of this group attain ordinarily only the size of a split pea (6 to 8 millimeters). This uniformly restricted size of growth can be interpreted in but one way. The elementary epithelium proliferates so rapidly that the nodule approaches cancerous change before the tumor has become large enough to be played on by the forces of peristaltic action or before the more temperate connective tissues have a chance to respond to such demands for growth. Figure 5c shows this changed epithelium already in actual contact with the submucosa.

It is this lag in the connective tissue stroma that gives to polyps of group 3 their characteristic appearance of rank confusion in the epithelial overgrowths. Cellular activity at the points where the tubules open on the surface must result in a disorganized nodule if there is no connective tissue to support an orderly papillary projection. And a similar course must be followed in the buds in the tubules themselves. Here the enlarging tubules must grow downward, as there is no structure to sustain an upward proliferation, and, in fact, tubules are to be seen proceeding into the normal mucosa from which they have developed and which they will ultimately infiltrate, compress and destroy. As in group 2, the irregular tubules become so convoluted that they are frequently obstructed, and numerous cysts are formed behind them. All in all, in the polyps of this



Fig 10. a Section of adenocarcinoma graded 2 marked B in Figure 9. The carcinoma has advanced to the serosa and there remain in it only scattered traces of a former polyp epithelium but confirmatory evidence that this carcinoma had its origin in polyp is contained in the neighboring growths one of which is pictured in Figure 11. b Enlargement of this carcinoma. This may be compared with one of polyp in Figure 11a. Case 2.



Figure 11: a, Microscopic appearance and b, cross section through a polyp of borderline group 2 3, 1.5 centimeters in diameter, suspended on a pedicle 3 centimeters long (Fig 9C). The polyp is practically destroyed by the advancing adenocarcinoma, graded 2. Had not the growth of this carcinoma been cut short by the extirpation, the picture shown in Figure 10 inevitably would have been produced. Case 2.



Fig 12: Resected segment of the rectum and rectosigmoid showing: a, site of polyp of group 2, 1 centimeter in diameter. b, Sites of other and smaller polyps of group 2, polyps which in themselves in time become carcinomatous, points directly to the conclusion that carcinoma of the colon is mediated through proliferations of group 3 wherever their situation. c, Deep seated destructive adenocarcinoma, graded 1. Case 3.

group no recognizable attempt is made at organoid formations. In addition, cells of these epithelial complexes can no longer be distinguished morphologically from those seen in outright carcinoma. It apparently is but a matter of relatively short time until polyp proliferations of this type burst the barriers of the muscularis mucosae and become actually deeply infiltrating, that is, carcinomatous.

In considering the sites of the proliferations of group 3, it was mentioned that they have been found scattered throughout the intestinal mucous membrane. Similar areas of this same type of proliferation are to be seen also on the surface of some polyps of group 2. In these buds of solid cords of epithelium, the cells, no longer moored to the glandular structure of the tubule, have thrown off their columnar cell characteristics and have become one eyed vesicles, the form for the repeatedly described and so called carcinoma cell.

We are prepared to prove that the site of origin of deep seated destructive carcinomata of the colon is in these proliferations of the mucous membranes of group 3. The finding of such an order of proliferation in polyps of group 2, polyps which in themselves in time become carcinomatous, points directly to the conclusion that carcinoma of the colon is mediated through proliferations of group 3 wherever their situation.

It may be well to repeat here that the nodular polyps of group 1 pursue ordinarily a benign career, that the orderly but more rapidly growing polyps of group 2 tend in time to malignant changes, and that formations of the order of group 3 are outrightly precancerous. The data on which these ideas are based will be found in the forthcoming presentation and analysis of the cases of polyposis in this series. The first 3 of the 13 cases are reported with considerable fullness, the remainder in less detail, and all are summarized in the table.



Fig 13. Congeries of polyps of group 3 in which are areas of adenocarcinoma graded 2. This is the second of three separate carcinomas in this specimen. There is striking resemblance of this picture to one shown in Figure 8. The Schultze picture is present. Case 5.



Fig 14. Resected portion of rectum and rectosigmoid. A cross section of this massive polyp of group 2 is shown in Figure 15b. The sites of numerous smaller polyps of group 2 and group 3 are circled. Case 9.

REPORTS OF CASES

CASE 1. The patient is a woman aged 25 years. The mother who is living is said to have carcinoma. All her life the patient has had diarrhea; she did not remember that she ever passed formed stools. On the day of her first examination at the clinic 100 cubic centimeters of blood was lost in rectal bleeding. Over a period of many years she had not observed any change in her general condition and had not lost weight. The concentration of hemoglobin was 16 grams in each 100 cubic centimeters of blood. On proctoscopic examination multiple polyposis was discovered beginning just above the anus and involving the bowel as far as it could be seen. There was a scarred area 2 centimeters in diameter about 3 centimeters above the anus. Above this and to the right was another similar area that appeared malignant. A specimen was removed and was diagnosed as adenocarcinoma graded 1, in an adenoma.

Abdominal exploration was made and ileostomy was established. Three months later the entire colon was removed *en masse* with 14 centimeters of ileum and the upper portion of the rectum. Shortly afterward at posterior resection the rectal stump was reworked.

Pathological changes. The two gross specimens, the one consisting of 14 centimeters of the terminal part of the ileum, 70 centimeters of the colon down to and including the upper portion of the rectum and the other of the rectal stump, were both involved in a generalized process of polyposis. In the upper rectal segment was a hard ulcerated and deeply excavated buttonlike oval area 3.5 centimeters long by 2.5 centimeters wide obviously carcinoma. Of the innumerable polyps two were of notable size (Fig. 6). One of these polyps was a giant raspberry like growth 6 centimeters long 4 centimeters wide and 2 centimeters thick from a sturdy pedicle arising in the mucosa near the ulcerated carcinoma just described. The other similar but slightly smaller one hung into the lumen at the splenic flexure. Scattered over the colon were hundreds of other pedunculated polyps varying in size from those whose tiny stalks were hardly visible to others

of dimensions of 2 by 2 centimeters. Studding the mucosa between these pedunculated growths and more closely in the rectum were still other uncounted hundreds of minute warty excrescences 1 to 5 millimeters in diameter so called sessile polyps. The mucosa except at the site of the carcinoma and at the bases of the polyps was normal in appearance and texture. The folds that ordinarily mark the mucous membrane of the colon were still maintained.

Microscopically all of the little sessile growths encountered in this specimen were typical polyps of group 3 conforming to the descriptions and illustrations given for this type of tumor (Figs 5 a b c). The large ulcerated area was an adenocarcinoma graded 2. No trace of a former polypoid stage of development could be seen within the growth (Fig. 7). But remarkably enough in a conglomerate mass of little polyps of group 3 surmounting a rectal fold was discovered a tiny adenocarcinoma graded 2, 2 millimeters in diameter (Fig. 8) which had destroyed all evidence of mucosa at this point and had already advanced deep into the submucosa. In the massive pedunculated polyp suspended in this same neighborhood were discovered likewise areas of adenocarcinoma graded 1. And in the big pedunculated polyp described as arising near the splenic flexure were similarly discovered areas of adenocarcinoma graded 1. Both of these polyps were otherwise typical and unsuspected tumors of group 2. Numerous other polyps of this same order group 2 were scattered about. Polyps of group 1 were not found in the specimen.

This specimen offers for analysis a remarkable array of polyps in all phases of development, and more uncommonly, four separate centers of carcinomatous change, each presenting its own picture in the progressive growth of deep lying and destructive carcinomata of the colon.

In Figure 8, the minute and microscopic adenocarcinoma, graded 2, derived from progressive changes in polyps of group 3 already had penetrated deep into the submucosa, destroying it as it destroyed the mucosal elements above it. Obviously it would have been only a brief time until this advancing growth would have attained the size of the larger carcinoma near it. The



Fig 15 a Carcinoma growing in the remnants of tubules of a polyp of group 2. Numerous islands of polypoid epithelium have so far escaped destruction in this growth. b Cross section of massive sigmoidal tumor pictured in Figure 14. Case 9.

histological pictures of these two growths in two different periods of development were so nearly identical that they could be used practically interchangeably (Figs 7b and 8A). The larger of the two carcinomata is thus to be regarded as the older brother of the smaller one. But we have actually seen the tiny cancerous offshoot microscopic in dimensions, arising in polypoid progenitors of group 3. It follows then, that the histogenesis of the two growths was the same, and hence they are forms of the same type of growth and differ only in point of age, although in the larger tumor all evidence of a former polypoid structure had been destroyed.

In the initial areas of carcinomatous change in the peripheral parts of the two massive polyps of group 2 were proof, also, that even stable old growths of this type tend ultimately to malignancy. It would seem that polyps of group 1 and group 2 are the products of a proliferative disease of the intestinal mucosa when the rate of development of that disease was slow and its import benign. Polyps of group 3, on the other hand, are its products when the disease is progressing at an accelerated pace.

CASE 2 In the family of a woman aged 38 years there was no history of carcinoma. Only 5 weeks before the patient came to the clinic she was first made aware of change in bowel habits by the onset of diarrhea. This diarrhoea, together with abdominal distention and cramps, persisted until operation.

Proctoscopic examination revealed an annular carcinoma involving the lower end of the sigmoid. Motion was limited on the left posteriorly and the bowel was partially obstructed. Two polyps appeared below and at the sides of the growth. An obstructive type of resection was done. Subsequently the opening made at colostomy was closed.

Pathological changes The specimen consisted of 20 centimeters of sigmoid (Fig 9). In the upper third of this segment of the bowel were two lesions each 3 centimeters in diameter. Both portions were deeply ulcerated; the ulceration in the higher of the two extended through all the coats of the bowel and into a mass of indurated tissue which penetrated 5 centimeters or more into the mesenteric attachments. At a level of about 5 centimeters below these destructive growths were two racemose polyps, each 1.5 centimeters in the greatest diameter and each suspended from opposite sides of the sigmoidal walls by stems 3 centimeters long. In the mucosa below the growths and extending to the lower limits of the specimen were twelve or more tiny warty excrescences ranging from 1 to 5 millimeters.

Microscopically the deeper penetrating growth which involved the mesenteric nodes by direct extension was adenocarcinoma graded 2 and the nearby but slightly smaller lesion was likewise adenocarcinoma graded 2. Furthermore in the heart of each of the two polyps cut on their long stems was adenocarcinoma graded 2 of the precise histological picture as presented by that in the penetrating carcinomata. Microscopic enlargements of all four of these separate carcinomata were indistinguishable one from the other (Figs 10a, b and 11a, b).

The two large polyps, except for their regions of malignant change were of the order of group 2 or 3. The general structure of the polyps was that of common types of group 2 but the epithelium of the tubules not involved in the cancerous process was extremely dark, exceedingly active and in occasional areas only was there any evidence of production of mucus (Fig 11). The smaller scattered polyps were all typical growths of group 3: tiny tufts of mucosa capped by unsupported congenes of polyp tubules in the process of active proliferation.

In this case, as in the preceding one, there appeared four distinct centers of advanced carcinoma. The only interpretation that logically can be offered for this situation is that four of the numerous proliferations of group 3 noted in the foregoing analysis have progressed to outright carcinomatous forms. It might be con-



Fig 16. Colon resected for generalized polyposis. The dense growth of innumerable polyps of borderline group 2/3 is strikingly shown. (Case 13.)

tended justly that the two major deeply penetrating growths are of the same origin. Without serial sections of the disputed portion this objection could not be silenced. However, the point could be granted without reducing the force of our interpretation of the march of events in this instance. There would still remain three regions of equally destructive carcinomatous formations appearing in three separate structures, two of them in removed and disconnected polyps of group 3.

CASE 3. One uncle of a man aged 56 years died of carcinoma of the stomach and another uncle of carcinoma of the bowel. Only 3 months before coming to the clinic the patient's life-long bowel habits were interrupted by the onset of much rectal tenesmus which could be relieved by the passage of varying amounts of stool mixed with blood and mucus. Proctoscopic examination disclosed high in the posterior rectal wall an easily movable cauliflower mass.

Biopsy revealed the growth to be an adenocarcinoma graded 1. Combined abdominoperineal resection of the rectum and rectosigmoid was accomplished with simultaneous colostomy by inguinal stab wound.

Pathological changes. The gross specimen was 25 centimeters of rectum and rectosigmoid. About 10 centimeters



Fig 17. a and b. Progressive steps in the repair of injury to mucosa and submucosa caused by rupture of inflamed lymph follicles by means of downgrowth of normal epithelial elements. It may be noted that the normal and not the overlying polyp epithelium participates in this ingrowth. In Figure 13 is an example of this process being carried on at large scale.

above the anal margin was a flat warty excrescence 4 centimeters long and 3 centimeters wide which projected above the surface of the bowel 0.5 to 1 centimeter. In the center of this mass was a small region of ulceration with loss of substance. Within 4 centimeters of this growth and at its approximate level was a large pedunculated mulberry-like polyp 2.5 centimeters in diameter. This tumor was much darker than the flatter one and in the gross was an excellent example of what passes routinely in laboratory practice for a pedunculated adenoma. About 6 centimeters above these two major growths was another nodule 1 centimeter in diameter. It was situated on the crest of a fold of mucous membrane and in its color and texture it was not changed from the normal appearing mucosa from which it arose. On closer inspection there were to be seen throughout the mucous membrane on the ridges of the folds and in their depths numerous tiny warts, some so small that they would have escaped recognition except for the use of the hand lens and others ranging up to 2 millimeters in diameter. These little warts in color and texture were also like normal mucous membrane (Fig 12).

Microscopically the large pedunculated tumor was a typical polyp of group 2 but in many places over its surface were numerous finger-like proliferations, papillary carcinoma graded 1. Acini and crypts in this growth could easily be located which would be lined in part by epithelium of group 2 and in part by outright cancerous growths. In the cross section of the large tumor was a deep seated destructive growth adenocarcinoma graded 1. In this carcinoma which had destroyed in its area most of the musculature of the outer intestinal walls, pictures were to be seen that could as well have been taken from the pedunculated polyp. Here the carcinoma was developing on remnants of polyps of group 2. Here also the carcinomatous and polyp cells lined the same acinus or met on the surface to form the investment of the tumor.

The growth that was 1 centimeter in diameter was a typical polyp of group 2. Evidence of carcinomatous change could not be found in it at this time. The other and smaller polyps were all incipient growths of group 2 the tiny stalks sustaining early polyp formations.

In this specimen were presented clear cut pictures of the progress of events from proliferations of group 2 to deep seated carcinoma. In Figure 12, a, is shown a so called benign polyp, in Figure 12, b, there appears outright carcinoma in an exactly similar polyp, and the carcinoma appearing in the unmistakable remnants of group 2 polyp (Fig. 12, c), has proceeded to the destruction of all but the outer coats of the intestinal wall. In the face of these pictures, no other interpretation of the processes of growth of this destructive carcinoma could reasonably be offered.

CASE 4. In this case masses of carcinoma appeared in bulky polyps of group 2. No one would dispute the origin of such formations. If the patient had not reached operation and the ulcerating growths were thus allowed to enlarge, it is obvious that it would be but a short time until all evidence of this preliminary polypoid state would be destroyed.

There was also an active polyp of group 2 or 3 between two large carcinomata obviously too carrying within itself the developmental patterns of the two older growths. Had this polyp been situated in the proximal loop and gone undetected, in all probability the patient would soon be facing a recurrence.

CASE 5. In this case also (Fig. 13), as in the preceding case (Case 4), multiple centers of carcinoma of undoubted polypoid origin were present. The sites of the carcinomatous changes were at once apparent. The solitary polyp of group 2 in this case was obviously older than the similar one in the specimen of Case 4 and was itself already involved in actual carcinomatous proliferation.

CASE 6. There are two bulky carcinomata in this case as there were in the two preceding cases (Cases 4 and 5). They call for no detailed tracing of their development. The origin of tumors of this type in polyps is self evident and everywhere admitted.

CASE 7. In the specimen which represented this case were two advanced adenocarcinomata, graded 2. The cross sections made of both carcinomata failed to show any evidences of a former polypoid phase in the growth. However, there were likewise present in the specimen numerous exceedingly active polyps of group 3. It would be difficult to assign any other origin to these carcinomata than the overgrowth of two or more of these rapidly proliferating polyps.

CASE 8. Unless the regions of the carcinoma in this case which had not yet come to ulceration, were examined microscopically the growth would be said to be an adenocarcinoma, graded 3, without evidence of a former intermediate polypoid stage of development. The close identity of structures in the upper and intact portion of the major growth with those seen in the adjacent polyp makes it difficult to deny that the major penetrating growth had its origin in polypoid proliferations.

CASE 9. A massive carcinomatous growth (Figs. 14 and 15), like the two major growths in Cases 4, 5, and 6 appeared in this specimen. Attention need not be given here to tracing the details of its development. Cross section of this carcinoma is self revealing. The case is inserted simply to record another instance of outright deep seated destructive carcinoma arising in polypoid soil.

CASE 10. The specimen which represents this case presented another example of malignant outgrowth of extensive polypoid proliferations. It may well be that not

all the centers of carcinoma in this broad expanse of polyp formation were primary growths. Many of them were certainly branching projections of a central nidus. But it is sufficient for our thesis to show that there was one such nidus in the tumor. There was no evidence of carcinoma other than in this polyp. Therefore the carcinomatous change must unquestionably have started in the polyp.

There was a sessile polyp of group 3 near the upper border of the carcinoma. This polyp which was about to be included by the malignant advance pictures the fate that must often overtake these numerous tumors at those times when a high grade carcinoma has taken possession of the field.

CASE 11. Figure 5 a, b, c illustrating standards of classification for our grouping, was taken from the specimen which exemplifies this case. With plain evidence of restless activity in the cells of the numerous polyps it would be difficult to regard them as guiltless in the formation of the large and destructive carcinoma which appears in the specimen. It must be remembered, too, that it is not uncommon for polypoid growths to be suppressed to actual regression once a fullgrown carcinoma dominates the proliferative activities of a field.

CASE 12. This is a case of widespread but slowly progressing proliferative disease of the gastro-intestinal mucous membranes. Except for the symptoms arising in the duodenal ulcer the patient's difficulties through 13 years were due to purely mechanical derangements secondary to these slowly growing but large tumors.

CASE 13. In the remarkable specimen which represents this case (Fig. 16) polyp epithelium of group 3 reached its maximum for all these cases both for intensity and extent of its activities. The disease was called polyposis. It could have been called as well adenocarcinoma, graded 1, but tradition and the textbooks oppose such a diagnosis. Perhaps the presence in the specimen of the innumerable long stemmed polyps gave to the diagnosis its dubious benign cast. Long pedicles, it seems, have high standing, at least clinically in the criteria of innocence in new growths. And perhaps, too a pathologist could not be expected to term these tumors carcinoma, when they are in such great numbers even though they are all but characteristic of carcinoma. One has only to consult the literature or to refer to Case 1 of this series to be reminded that these tumors would have become carcinomata had not their life been cut short by extirpation. But we will have to content ourselves with calling this precancerous polyposis.

RECAPITULATION

The data gathered for the reports of cases are hardly suitable for statistical presentation. All but 3 of the 13 cases so reported came to operation because of carcinomata known to be present in the several rectal and sigmoidal colons. Only two of the specimens were extirpated primarily for polyposis. Thus an analysis of these specimens, the polyps of which were secondary considerations in the operative indications, will not reflect the incidence of such tumors in any representative number of colons. But this study, directed as it is into a review of the histopathological characteristics of polyps and into the histogenesis of carcinoma of the colon, does reveal some arresting relationships between the two forms of new-growth for this particular

POLYPS OF THE COLON AND CARCINOMATA
DERIVED FROM THEM

| Case | Polyps | | | Carcinomata | | |
|------|------------------------------------|------------------|----------|--------------------------------------------------------|------------------|--------------------------------|
| | Number | and distribution | Group | Site | Rate | Polyp group from which derived |
| 1 | Generalized polyposis | | 3 and 13 | Rectum Rectal ampulla Sigmoid Splenic flexure | 2 2 1 1 | 3 3 2 2 |
| 2 | 2 large and 4 scattered | | 2 and 13 | Sigmoid Sigmoid Sigmoid Sigmoid | 1 1 2 2 | 2 2 2 2 |
| 3 | 6 scattered | | 2 | Rectum sigmoid Rectum sigmoid | 1 1 | 2 2 |
| 4 | Solitary large and 11 small | | 2 and 13 | Rectum Sigmoid | 1 2 | 2 2 |
| 5 | Solitary and 6 negroes | | 2 and 13 | Sigmoid Rectum Sigmoid | 1 2 3 | 2 2 2-3 |
| 6 | Remnants only in the carcinoma | | 2 | Rectum Sigmoid | 1 1 | 2 2-3 |
| 7 | 8 exceedingly active | | 3 | Rectum Sigmoid | 1 1 | 3 3 |
| 8 | Solitary and remnants in carcinoma | | 2 | Rectum Rectum | 3 1 | 2-3 3 |
| 9 | 10 | | 3 | Rectum | 2 | 2 |
| 10 | 2 large and 3 small | | 2 and 13 | Rectum sigmoid | 1 | 2-3 |
| 11 | 12 | | 3 | Rectum | 1 | 3 |
| 12 | 1 caecal and 1 in descending loop | | 2 and 13 | None | | |
| 13 | Generalized polyposis | | 2 and 13 | None | | |

series. The arrangement in the tabulation of the pathological changes found in our cases presents a summary of these relationships.

In the 13 cases of polyposis of the colon, in either the generalized or localized form, there appeared 24 carcinomata. These 24 carcinomata were distributed through 11 of the cases (85 per cent) and thus only 2 cases were free from malignant change. In 8 of the 11 cases, 21 of the 24 growths developed and the ratio of incidence of multiple to single malignant growths in this polyposoid soil was 8:3.

For 19 of the 24 carcinomata (79 per cent) there was, in the several specimens themselves, indisputable histological proof that the sites of origin of the malignant growths were in polyps. For 3 of the remaining carcinomata there was the most persuasive and convincing proof for the same site of origin. For only 2 of the 24 carcinomata does one have to go outside of the specimen itself for plausible evidence of such an origin. And, accordingly, however scrupulous

one may be in the matter, 22 of the 24 carcinomata (92 per cent) can be shown to be derived from polyps. If microscopic slides picturing the carcinomatous change in the polyp are not demanded as proof of such change, and if evidence of analogous and demonstrable developments in similar cases is acceptable as proof, then all of these carcinomata can be shown to have this origin in polyps.

There thus remains only the malignant growth in Case 2 and the one in Case 11, for the histogenesis of which one has to look outside the specimen itself. Although these two carcinomata destroyed by overgrowth and ulceration their own evidence of an earlier stage as a polyp, such evidence legitimately can be supplied to them from any of the other numerous cases in which the derivation of the carcinomata can be traced back, in unbroken lines, to polyps. In the study of the histogenesis of these 24 carcinomata is the inescapable conclusion that carcinoma of the colon develops from an earlier stage as a polyp or through an intermediate stage as a polyp and not otherwise. Certainly, in the light of this evidence, the burden of proof is on anyone who might wish to show that carcinoma of the colon develops in any manner other than through formation of polyps.

An analysis across these data in the opposite direction to determine how many polyps actually became cancerous would be an impossible task. In the cases of generalized polyposis there were literally many thousands of these tumors. Such numbers alone made impractical any plan for sectioning them all. And further, in the bulky polypoid carcinomata arising in congeries of polyps of group 3, one could never tell how many of the tumors were involved primarily in the change or how many were affected by secondary invasion of the malignant growth once it came to dominate the field. It is thus more important to observe that in every case but one in which there were polyps of group 2 or group 3, there were present also one or more carcinomata. The one case of the series in which there were growing polyps of group 3, but in which there was no outright carcinoma, is an instance of generalized polyposis (Case 13). The tumors were discovered incidentally at examination made routinely and before the inevitable development of carcinoma had attracted attention to this precancerous soil. One has only to be reminded of the similar instance of polyposis in Case 1 to realize the fate that surely awaited these polyps of group 2 and group 3, had not the growth of the tumors been cut short by extirpation of the entire colon. It is

to be noted at this point, too, that in the one case in which polyps of group 1 predominated, carcinoma was not found.

It would be likewise valueless to attempt to determine the separate ratios of carcinomata to proliferations of group 2 and group 3. It is much more useful to bracket these two groups together. Although carcinoma undoubtedly arises in greater proportional frequency and more surely in polyps of group 3, that very fact tends at once to destroy the evidence of such development. Unless the specimen is resected early in the course of the carcinomatous growth, these minute polyps, none of which exceeds 6 millimeters in diameter in size, will be completely overgrown and their part in the genesis of the carcinoma thus concealed. Consequently, we find many more polyps of group 2 bearing carcinomatous growth than those of group 3. But it is always in polyps of group 3 that we find the tiniest carcinomatous growths. And it must be remembered, too, that group 2 is numerically the largest and into it fall most of the polyps. Polyps of group 1 are too slow in their growth ever to become important as centers of carcinoma, and polyps of group 3 are too early overtaken by carcinomatous change to retain long their status as polyps.

Metastasis. Any consideration of multiple carcinomata, especially multiple carcinomata of the same order and grade and in the same organ, must reach sooner or later the problem of metastasis. Without serial sections of all of these specimens, including the whole of the colon in Case 1, it could not be denied absolutely that some of these carcinomata are the metastatic expression of some of the others. But reasonable certainty in the matter demands no such impossible proof. We have shown for the 24 carcinomata in this series that the sites of origin of the carcinomata are in polyps and not elsewhere. The literature is full of instances of carcinoma occurring in polyps in various persons. If, then, one polyp in a field becomes carcinomatous under whatever influence is operative there, other polyps in the same field are just as likely to experience the same change. Furthermore, in the examination of the hundreds of tumors in these specimens, no evidence was uncovered to indicate that metastasis accounted for any of the carcinomata. It is true that numerous polyps in the mucosa in the neighborhoods of rapidly growing carcinomata are to be seen on the point of being invaded and destroyed. But the involvement of the polyps in this manner is by direct extension and not by metastasis.

If, for instance, in Case 1, metastasis were to account for any one of the four carcinomatous centers obtaining there, one would have to argue that such metastasis took place only from polyp to polyp and that the intervening mucosa, submucosa, and stalks were in some manner miraculously exempt from the workings of the phenomenon. This, indeed, leads to absurdity, but it comprises about all the support that can be mustered to place these multicentric regions of cancerous change on a basis of metastasis.

Recurrence. Recurrence is a commonplace of surgical procedures or of carcinoma. But in carcinoma of the colon, especially of its left side, recurrence may not be recurrence at all. Unless all of the polyp-bearing mucosa of the organ is removed at the time of operation, other of these tumors thus left to grow may well work out their destiny in carcinomatous change. Particularly, is this true of the older type of operation of inguinal colostomy and posterior resection. In abdominoperineal section, more of the untrustworthy fields of polyp of the colon are removed and the possibility of both genuine and spurious recurrence is definitely reduced.

Schultze pictures. In examining microscopic specimens of the colon, one notices with surprising frequency points at which the mucosa seemingly dips down deep into the submucosa, forming a crypt. Longitudinal sections at these points give rise to the impression that an invasive process of epithelial proliferation is under way. These invasions may be numerous in one specimen and entirely absent in many others, a fact that once helped to bring the growths under surveillance as suspicious processes in the histogenesis of carcinoma of the colon. In 1905, Walter Schultze traced the development of such processes not only in colons of adult persons but also in the large bowels of infants and embryos. Later he examined the intestines of many animals, both of the familiar domestic species and of a great variety of the zoological orders found in the menageries of Berlin and other German cities. It was his conclusion that the process is widespread in both man and beast and that although the heterotopic epithelium establishes its position by invasive action, the resulting formations are, nevertheless, normal in structure and intent, and never carcinomatous. The development of these processes, since called Schultze pictures, is secondary to the rupture of an inflamed mucosal or submucosal lymph follicle. The sinus tract thus formed is quickly healed by the downgrowth of units of mucous membrane.

In Figures 17a and 17b, the development of these pictures is shown in its various steps and in varying degrees of magnification. It is to be noted that the normal epithelium and not the epithelium of the polyp is here involved. In Figure 13, this selective action of the mucosa is even more strikingly shown. In this instance the overlying epithelium is either of a carcinomatous or polypoid order, yet the Schultze picture is formed from normal mucous membrane. It cannot be said, of course, in this case that the upward and downward proliferations were simultaneous. It is to be noted, too, that in none of these regenerative centers has the newly formed epithelium exceeded the boundaries of the injured lymph follicle. Thus there is in these Schultze pictures pointed evidence that hyperplastic proliferation in the intestinal mucosa may be reparative and useful. It is only when these proliferations occur from unknown cause and at useless times and places that there are developed precancerous formations.

The cell carcinous and precancerous. In the accounts of pathological changes the epithelial elements of the polyps of group 2 were repeatedly described as being composed of single layered, enlarged cells, tightly compressed into columnar forms, showing blunt rod shaped, deeply staining nuclei and the marks of sharply diminished production of mucus. This polyp epithelium is easily distinguished by these characteristics from the epithelium of normal mucous membrane. The distinction between normal epithelium and that of polyps of group 3 was shown to be even more striking. In the polyps of this group, the cells proliferate in multilayered cords and alveoli, their shape and that of the nuclei tend more and more to vesicular, roughly spherical forms, the production of mucus is practically abandoned, and numerous subsidiary nucleoli and mitotic figures appear. This description of polyp cells is, indeed, directly applicable to carcinomatous units. If there is a morphologic distinction between the two forms at practical magnifications, the line of such distinction is extremely fine and exceedingly devious. It is as a matter of fact by means of arrangements of glandular tubules and disposition of connective tissue that we separate the two forms of growth, and thus, for polyps of group 3 such epithelial proliferations approaching so closely in form and behavior to outright carcinoma must be regarded

as definitely precancerous, and must be so treated.

SUMMARY AND CONCLUSIONS

The foregoing histological studies were based on 13 cases of polyposis of the colon. Two of these cases were instances of generalized involvement of the lower part of the bowel and should be added to the 127 other reports in the literature of this uncommon form of extensive proliferative disease of the large intestine.

The arguments of this study supported by histological evidence could be briefly summarized in this manner:

1 Characteristic structural variations in polyps of the large intestine serve as readily recognizable criteria for the classification of the growths into three major groups, each of which not only presents pathological unity but also and more importantly, follows a definite predictable clinical course.

2 Of the three groups, group 1 alone is entitled to the benign implications remaining in the name polyp, group 2 tends inevitably in time to malignant change, and group 3 is an immediate precancerous formation.

3 The three phase plan of classification, as outlined here, is a convenient refinement in pathological descriptive practice, and a useful clinical guide to operation and prognosis.

4 The site of origin of 22 of the 24 carcinomata in this series was traced back through unbroken lines to polyps. The genealogical evidence for these growths, and that to be found in the literature for other similar carcinomata, argue persuasively for the extremely plausible contention that the histogenesis of carcinoma of the colon is mediated through precancerous polyp formations and not otherwise.

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SECONDARY PLASTIC REPAIR OF THE COMMON DUCT

A NEW AID IN FINDING THE PROXIMAL STUMP¹

LAWRENCE JACQUES, M D, CHICAGO

Associate in Surgery Northwestern University Medical School

MUCH has been written and said concerning methods for the repair of bile ducts injured at operation. While the technical problems involved in restoring continuity are extensively dealt with, little mention is made of the difficulties encountered in identifying and isolating the injured structures before plastic procedures may be undertaken. The attempt to secure adequate exposure may involve a long and trying dissection in patients by no means prepared to withstand the trauma and shock of extensive surgery. Not infrequently the attempt must be abandoned before both ends of the severed duct have been secured. Measures designed to hasten and facilitate exposure of either cut end should therefore be most welcome.

The approach to the proximal stump of a severed duct is usually made along the tract of the biliary fistula which has been allowed to form. The course of this tract may be marked in suitable cases by the injection into it of a dye, such as methylene blue, which stains its lining, or by the introduction of probes or catheters. Unfortunately, these maneuvers do not always guide the surgeon accurately to the very mouth of the injured duct. It is true that this opening is usually patent and pouring forth bile. But this is liver bile—thin, lemon yellow, often scanty, recognizable on gauze sponges, but readily obscured by oozing, and scarcely standing out against the color of the tissues. It would seem desirable to alter the bile escaping from the open end of the duct in such a way as to facilitate the detection of its source.

The color of the bile may easily be altered by the systemic administration of various dyes excreted more or less selectively by the liver. This alteration in color has been made the basis for a method of estimating liver function, the rapidity and degree of elimination of the dye employed being measured on aspirated specimens of duodenal content. The use of indigocarmine for this purpose was initiated independently by Hateganu and Lepehne, and further clinical work with this dye in determining liver function has been reported by Einhorn and Laporte, Bossert and Loers, and Kusznezow. A study of the literature and preliminary experi-

ments on animals led to the adoption of indigocarmine for the purpose here described.² This choice was based on the availability of the substance, its lack of toxicity, the promptness and directness with which it produces the desired change in color, and the sharpness with which the blue green color produced stands out against the tissues.

In the following case, indigocarmine was given intravenously to facilitate the localization of the proximal stump of a severed common duct. The procedure was of such distinct help that it is deemed advisable to record the results at this time.

Mrs. E. K., 62 years old, entered the Passavant Memorial Hospital on the service of H. M. Richter on April 4, 1930. She stated that she began to have attacks of abdominal distress about 10 years previously. In March, 1929, she was operated upon elsewhere; her gall bladder and appendix being removed. The gall bladder contained no stones. Because of a persistent biliary fistula, a second operation was performed a week later. It is not known what was done at that time. After 2½ weeks the fistula closed. There was no further trouble until June, 1929, when she developed pain in the region of her wound and her temperature rose to 103 degrees F., after which the fistula reopened, drained for 10 days, and closed. During the following months there were no symptoms except for frequent transient attacks of fever and malaise. In September, 1929, jaundice was first noted by a physician. This gradually deepened. On April 4, 1930, when she entered the Passavant Hospital, she complained only of jaundice and weakness. Her weight had fallen from 125 to 78 pounds. On examination the skin, oral mucosae and sclerae were deeply jaundiced. There was a surgical scar 10 centimeters long in the right upper quadrant. The liver was smooth and firm, palpated 6 to 7 centimeters below the costal region. There was no abdominal tenderness or rigidity. The stools were clay colored and contained no bile. There was much bile in the urine. On April 7, 1930, a quantitative van den Bergh showed 4.0 milligrams per 100 cubic centimeters of serum. On April 8, 1930, an exploratory laparotomy was performed. There were most extensive adhesions between stomach, duodenum, liver, and anterior abdominal wall. The liver was hard and irregular. After a long and difficult separation of adhesions, particularly those extending between liver and duodenum, the distal portion of a severed common duct was isolated. Further search disclosed the bed of the gall bladder and a large amount of scar tissue, but repeated probeings and aspirations failed to reveal the proximal stump of the duct. Because of the patient's general condition (systolic

¹The experimental work was performed several years ago when the writer was a Baer Fellow in Pathology at the Nelson Morris Institute for Medical Research of the Michael Reese Hospital, Chicago.

²From the surgical service of H. M. Richter, M.D.

blood pressure had fallen to 70) it was deemed unwise to continue the search. A black silk marker was sutured into the distal stump, a cigarette drain was inserted in the hope that a fistula might form and the wound was closed. The blood pressure rose steadily and in several hours had returned to normal. On the following day there was a profuse bile stained drainage from the wound. This drainage persisted and simultaneously the jaundice decreased in intensity so that by May 10 the quantitative van den Bergh had fallen to 1 to 5 milligrams per 100 cubic centimeters. On May 5 a trial intravenous injection of 5 cubic centimeters of indigocarmine was made. A change in the color of the fistula bile was noted 10 minutes later. This change gradually became more pronounced in nine consecutive specimens collected at 5 minute intervals.

The medical management of the case was supervised by Dr. Paul Starr. On a high carbohydrate and low fat diet and with repeated blood transfusions, intravenous injections of glucose and oral administration of her own fistula bile the patient's general condition gradually improved.

Several days previous to the final operation the catheter which had been inserted into the biliary fistula slipped out and could not be replaced.

On June 5, 1930 a laparotomy was again performed. The peritoneum was found to be obliterated by dense adhesions through which the course of the fistula could not be accurately traced. Immediately after the induction of anesthesia two ampoules (10 cubic centimeters of an 0.8 per cent solution) of indigocarmine were injected intravenously. After some difficulty the distal stump of the common duct was located by means of the black silk which had been sutured in at the previous operation. Search was then instituted for the proximal stump. Pale yellow bile in small quantities was escaping into the field but its source could not be ascertained. As the work progressed however the bile rapidly grew darker finally becoming a distinct bluish green. With this change the source of flow was promptly determined. The adjacent tissues were not stained. The orifices of both stumps were dilated with sounds and a catheter was passed through the distal stump into the duodenum. The proximal end of the catheter was then passed through the proximal segment into the liver and the ends were united as snugly as possible over the catheter. A free omental graft was tucked in about the line of suture, two cigarette drains were inserted and the wound closed. The patient made an uneventful recovery. At the end of a week no bile had discharged from the wound, the stools contained large quantities of bile and a quantitative van den Bergh was less than 0.7 milligrams per 100 cubic centimeters.

The amount of dye here used appeared to be adequate. In the presence of serious hepatic damage larger doses may be necessary and can be given with perfect safety. The harmlessness of this substance was emphasized by Chronscewsky and again by Voelcker. A frog, into whose lymph sac 1 or 2 grams of the pure dye have been introduced turns a deep blue but lives on unperturbed. Aligned toxic effects from its intravenous administration having in all probability been due to the use of too concentrated and, therefore incompletely dissolved preparations (Peterson).

The time of first appearance and maximum concentration of the dye in the bile after intra-

venous administration may vary considerably. Curves of excretion under normal and pathological conditions, as determined in specimens of duodenal content, have recently been constructed by Kusnezow. Excretion in normal individuals, according to this author, usually begins in 18 to 25 minutes, and continues for from 55 minutes to 2 hours and 20 minutes. The maximum concentration is usually reached about in the middle of the excretion period. A preliminary trial collecting 10 minute specimens of fistula bile after injection of the dye, should determine the dosage in each case.

Another possible use for the procedure here described suggests itself. It has been advanced as an argument against closure of the abdomen without drainage after cholecystectomy or common duct operations that minor damage to the principle bile ducts, the division of small accessory ducts, an imperfectly tied cystic duct ligature, or an incompetent suture line in the common duct may allow an escape of bile not readily noticeable at the time of operation, but subsequently resulting in a slow extravasation into the peritoneal cavity. It is conceivable that the previous administration of indigocarmine might materially aid in the detection of such leakages. The suggestion is made that it be given routinely in all cases in which difficult surgery of the biliary passages is anticipated.

CONCLUSIONS

1. Exposure of injured bile ducts is frequently more difficult than their plastic repair.
2. Indigocarmine, injected in adequate amounts intravenously, is excreted in the bile, stains it bluish green, and may aid in guiding the way to the proximal stump.
3. A similar procedure may be of value in detecting leakages of bile before closure of the abdomen following cholecystectomies and common duct operations.

I am greatly indebted to Dr. H. M. Richter for the opportunity of applying the method described in the present case.

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TEMPORARY PARALYSIS OF THE RECURRENT LARYNGEAL NERVES FOLLOWING THYROIDECTOMY

EARLE I. GREENE, M.D. F.A.C.S. CHICAGO
Instructor in Surgery, Northwestern University Medical School

OF ALL the accidents peculiar to surgery of the thyroid gland, injury to one or both of the recurrent laryngeal nerves is a most serious complication. Most injuries of the recurrent laryngeal nerves undoubtedly occur because of the unfamiliarity of the surgeon with their true anatomic position. Opinions, however, differ considerably as to the normal position of the nerves, one investigator stating that the nerve lies directly in the tracheo-oesophageal groove, while a second reports that the nerve occupies a more lateral position.

Higgins, in a study of the surgical anatomy of the recurrent laryngeal nerves, found that on the right side the nerve arises in front of the subclavian artery, passes around the artery, and then obliquely upward to the side of the trachea and passes behind the inferior thyroid artery ascending in the tracheo-oesophageal groove. About three quarters of an inch before it enters the larynx it divides into two constant fibers. On the left side it passes over the arch of the aorta, then winds around the arch just laterally to the ligamentum arteriosum, and passes upward along the tracheo-oesophageal groove. In the tracheal region the right nerve lies farther to the front than does the left.

Berlin and Lahey, in 22 dissections in animals, showed that in 18 the nerve on the right side was anterior to the inferior thyroid artery. In the 4 remaining cases the inferior thyroid artery was anterior to the recurrent laryngeal nerve. On the left side, the artery was anterior to the nerve in 19 dissections, in 3 the inferior thyroid artery was posterior to the nerve. As to the relative position of the nerves and the trachea, it was observed that they both run in the tracheo-oesophageal sulcus, with the left nerve often appearing a little deeper in the sulcus than does the right.

Fowler and Hanson, dissecting 200 cadavers found that the recurrent laryngeal nerve, in the region of the lower pole of the thyroid gland, lay 1 to 2 centimeters lateral to the trachea. In 262 cases (65.5 per cent of 400), the nerve passed posterior to the main branches of the inferior thyroid artery. In 104 cases (26 per cent) the nerve passed anterior, while in 34 cases (8.5 per cent) the nerve ran between the main branches of the inferior thyroid artery. In the majority of cases, the most intimate relation between the gland and the nerve was not at the lower pole as is generally assumed, but rather on the posterolateral surface at the junction of the middle and lower thirds.

Recently, Crile aptly said, 'It is not its anatomic location, however, but rather the vulnerability of its structure, the neighborhood changes of fixation and adhesions, and certain characteristics of the nerve conduction, which form the hazards. The slightest direct, or even indirect, pressure on the recurrent nerves, interferes with nerve conduction and immediately changes the voice. By contrast, the peripheral nerve fibers can undergo much trauma without resultant motor or sensory disturbance, but the naked recurrent nerve is almost as sensitive as is the naked brain, or the spinal cord. Struggle and survival probably have not influenced such vital organs as the larynx and trachea which have always demanded complete protection, the alternative being death. Whatever the cause, these nerves are exceedingly sensitive, exceedingly delicate, and the action current through them is easily blocked. In their vulnerability the recurrent nerves must be classed with the brain, the spinal cord, the optic, the auditory and the splanchnic nerves, the exceeding vulnerability of the recurrent nerve is, therefore

the first and most important factor in the production of abductor paralysis."

Judd, New and Mann, studying the effect of trauma upon the laryngeal nerves, made some interesting observations. These investigators traumatized laryngeal nerves in a manner similar to that which occur in an operation and subsequently studied the function of the vocal cords. When the nerve was pinched once with a hæmostat at various points, there was in every instance a paralysis of the cord supplied by the pinched nerve. In every instance, however, in animals living long enough, there was complete restoration of the function of the cord, varying in time from 30 to 60 days.

Ligation of the nerve invariably produced a complete paralysis which in every instance was permanent. Section of the nerve always produced a complete and permanent paralysis of the cord or cords innervated.

Traction by putting hæmostats under nerves for from 10 to 30 minutes caused no disturbance of the vocal cords. Stretching the recurrent laryngeal nerves acutely in a manner similar but of longer duration and intensity than occurs at operation resulted in no impairment of function of the cord. Stretching the nerve for a long period, as over muscles injured the vocal cords, but these investigators concluded that this was probably due to operative trauma and not to stretching.

Crisle, however, disagrees with these investigators as to the effect of stretching on the nerve. He feels that the most common direct cause of abductor paralysis is due to the pull on the nerve which may occur when the gutter is rolled out. He says "The most disastrous effect is produced when the nerve is disturbed by the dislodgement by the finger of an upper lobe which has thrust itself behind the larynx. Such a direct pressure and pull on the laryngeal nerves have probably caused more paralysis than either forceps or knife." He is of the opinion that any pull on the nerve may cause partial and temporary, or complete and permanent paralysis, and concludes that abductor paralysis is probably most frequently caused by traction.

That traction can produce paralysis of the recurrent laryngeal nerve was demonstrated forcefully recently by the following case operated upon by one of my colleagues.

CASE 1 The patient was operated April 15, 1930, for thyrotoxicosis. After the removal of the left lobe a bleeding vessel in the tracheo-oesophageal area was clamped without incident. At the completion of the operation the voice was normal and there was no respiratory embar-

assment. The following day, however, there were definite signs of respiratory embarrassment associated with some cyanosis. An examination of the larynx revealed a paralysis of the left vocal cord. The mobility of the right cord was reported as "sluggish." The cyanosis continued and a few days later definite signs of pneumonia were evident. The patient dying April 20, 1930. At the autopsy the site of operation was explored. Carefully dissecting the left recurrent laryngeal nerve it was found that a ligature which had been placed around the inferior thyroid artery caused an acute angulation of the nerve. The nerve itself was free except for the acute angle produced by the ligature which had been placed to control the inferior vessel. Had this patient lived it is safe to say the paralysis would have been only temporary.

Pressure from a hæmatoma can also bring about a temporary paralysis of one or both nerves. Recently such a case came under my observation.

CASE 2 The patient was operated for thyrotoxicosis April 1, 1930, the procedure being carried out almost entirely under local anesthesia, the patient being made to talk throughout the greater part of the operation. The gland was small, very firm, friable and bled profusely. At the completion of the operation a pack was inserted. The voice at all times remained unchanged. Forty-eight hours later the packs were removed. The next morning a swelling was noted on the left side which undoubtedly was a hæmatoma which appeared following the removal of the pack. It was deemed advisable to evacuate the hæmatoma but under no consideration would the patient or family permit of such a procedure. The following day hoarseness was noted and on laryngoscopic examination the left cord moved slightly. The next day the hoarseness was more marked and a complete paralysis of the cord was found. As the hæmatoma absorbed the hoarseness became less marked and function of the cord gradually returned. At the end of 4 weeks the voice was normal and the cord functioned normally.

Edema following thyroidectomy undoubtedly is frequently the cause of temporary postoperative paralysis. As the tissues swell, pressure is exerted upon the nerves resulting in a hoarseness and either a partial or complete temporary paralysis. Hoarseness and paralysis coming on 12 hours or more after thyroidectomy, the voice prior and immediately after operation having been normal, can best be explained by edema of the tissues. Manipulation around the inferior constrictors of the larynx and pressure on the posterolateral tissues of the gland itself may result in excessive reaction with subsequent edema and impairment of the nerves.

Permanent bilateral recurrent nerve damage is a catastrophe, having few equals in the realm of surgery. Injury to both nerves is associated with early obstructive dyspnea, and complete loss of voice. Examination of the larynx early, following such an accident, usually reveals the cords in the cadaveric position (half way between adduction and abduction) thereby narrowing the breathing space. Because of the inability to approximate the cords there is a complete loss of voice. Soon the cords occupy the midline position further

narrowing the breathing space, and is accompanied by obstructive dyspnoea, appearing at first after slight exertion, but soon becoming progressively worse until the patient cannot at any time breathe easily, requiring a tracheotomy for relief. The voice, following such an injury, according to Pemberton, usually returns in 3 to 6 months, but almost invariably accompanying the return of phonation, obstructive dyspnoea becomes prominent.

Bilateral temporary recurrent nerve paralysis is occasionally encountered. It may come on during the course of an operation, either from stretching of the nerves while mobilizing the gland, by pinching the nerves with a haemostat, from finger pressure on the nerves, or it may come on later (from 1 to 3 days or even later) as a result of oedema of the structures about the nerves, from haemorrhage about the nerves exerting pressure on them, or as a result of an accumulation of serum causing pressure on the nerves.

CASE 3 This patient was operated upon September 5, 1929, for a high grade hyperthyroidism. At operation a large and extremely firm gland was found. Toward the end of the operation the patient manifested marked inspiratory dyspnoea. An attempt was made to locate the nerve in the field of operation but this was not successful. The dyspnoea continued, and the voice was reduced to a whisper. The next morning because of continued dyspnoea cyanosis, choking and coughing a tracheotomy was performed—30 hours after the operation.

Laryngoscopic examination revealed immobility of both vocal cords. Seven days later the tracheotomy tube was removed with the idea of replacing it with a smaller one. The patient, after the tube had been removed, was so comfortable that it was deemed inadvisable to replace it. An examination of the larynx at this time showed a complete paralysis of the left cord, while the right cord showed some fluttering. Seven days later the laryngologist reported, "cords in cadaveric position. Some movement of the right ary tenoid on forced phonation, but none on left." The voice gradually improved and on October 18, 1929, the laryngologist reported as follows: "Both cords functioning, almost full movement on right with great improvement on left." One month later, November 15, 1929, the voice was normal and both cords were reported as functioning normally.

CASE 4 Patient was operated October 4, 1928, because of a high grade thyrotoxicosis. The gland was very friable and bled profusely. The voice at the completion of the operation and for the first 18 hours was normal. Gradually she became increasingly hoarse with some inspiratory dyspnoea. Examination of the cords the day after the operation showed a paralysis of the left cord with considerable oedema of the right cord which moved only slightly on forced phonation. One month later the voice was very high pitched and the cords were found in the cadaveric position. There was considerable inspiratory dyspnoea especially on exertion. Gradually the dyspnoea disappeared, the voice became stronger and 13 months after the operation, the voice was normal, and both cords moved normally.

CASE 5 Patient was operated March 3, 1923, for hyperthyroidism. Marked dyspnoea developed after

patient began to recover consciousness and examination of the larynx revealed a paralysis of both cords. The dyspnoea gradually lessened, the voice became stronger and on November 23, 1923, an examination of the larynx revealed an actively functioning right cord. The left cord was still immobile. The patient was lost track of until April 17, 1926, 3 years later, when an examination of the larynx revealed both cords functioning normally. The voice was normal and there was no respiratory embarrassment.

CASE 6 This patient was operated for hyperthyroidism May 24, 1923, and was apparently well until December 10, 1923 when there was a return of symptoms. She was again operated April 10, 1925, at which time moderate sized masses of thyroid tissue were found on each side of the trachea. The lower portion of the right mass was clamped and cut across, just above the lower pole, and a suture ligature was placed at the site of the clamp. Immediately inspiratory dyspnoea appeared which persisted after the removal of the ligature. Examination of the larynx showed a bilateral paralysis of the vocal cords. The dyspnoea subsided and the voice gradually became stronger. This case was further complicated by a severe postoperative parathyroid tetany and bilateral cataracts which required surgical intervention. Because of the severity of the tetany and the cataracts, and owing to the fact that the voice had gradually returned to normal, no examination of the larynx was made until April 13, 1928, at which time the cords were found to be normal.

Injury to one recurrent laryngeal nerve is frequently overlooked, neither the patient nor the doctor being aware of the accident, unless an examination of the larynx is a routine procedure, at which time one cord may be found paralyzed. The opposite cord, in such instances, compensates for its paralyzed mate and the patient may recognize no change in the voice. Rankin states that 1 per cent of patients have unilateral paralysis of the vocal cords prior to operation.

Most frequently, however, when there is an injury to one nerve, a change in the voice is noted, which may vary from a slight elevation of pitch to a marked hoarseness. As a rule the voice remains changed for a number of months, becoming more and more normal, as the opposite cord takes over the entire function. At times, however, the voice remains permanently changed, never returning to its normal caliber.

Obstructive dyspnoea is, as a rule, not present when only one nerve is injured. At times, however, injury to one nerve associated with marked oedema of the larynx will result in severe obstructive dyspnoea, requiring tracheotomy.

Unilateral paralysis, of a temporary character, coming on during the course of an operation, or appearing after operation, occurs more often than is usually suspected. Such a paralysis may last from several weeks to one year or more and is usually associated with a few postoperative reactions. A change in voice is usually the only complaint.

CASE 7. This patient was operated July 3, 1925 for an adenomatous goiter with hyperthyroidism. At the completion of the operation there was no dyspnea and the voice was normal. The following day the patient was definitely hoarse and laryngoscopic examination revealed a paralysis of the left cord. Gradually the hoarseness subsided and on September 8, 1925, 2 months after the operation the voice was normal and both cords moved normally. This case was undoubtedly one of postoperative paralysis resulting from edema of the tissues about the recurrent nerve completely disappearing after 2 months.

CASE 8. Operation for severe hyperthyroidism, November 8, 1926. There was considerable difficulty in delivering the gland and while attempting to mobilize the upper pole on the left side the patient suddenly developed inspiratory stridor which continued throughout the operation. Laryngoscopic examination showed a paralysis of the left cord. The inspiratory difficulty persisted for several days and although the right cord was normal the patient could not talk above a whisper. Gradually the stridor disappeared, the voice became stronger and 3 months later, February 28, 1927, the voice was perfectly normal and laryngoscopic examination revealed normal cords.

In this case the paralysis was undoubtedly the result of stretching the nerve as the upper pole was being mobilized, the paralysis disappearing after three months.

CASE 9. This patient was operated January 29, 1927 because of a high grade hyperthyroidism. There was no change in the voice until the second day after operation at which time definite hoarseness was manifest. An examination of the larynx revealed a paralysis of the left cord. Two months later, March 11, 1927, although there still was some hoarseness the laryngologist reported a paresis of the left cord with some motion which should improve. Six months later (July 13, 1928) the voice was completely normal and both cords moved actively.

CASE 10. This patient, a woman of 63 years, was operated upon for a toxic adenoma, August 19, 1927. The voice at the completion of the operation and for several days after operation was normal. On August 27, 1927, there was a note on the history stating that the patient had been hoarse for the past few days. Examination of the larynx revealed a paralysis of the right cord. On September 12, 1927, one month after operation the laryngologist reported a lagging of the right cord. One month later, October 21, 1927, the right cord was reported as sluggish. Ten months after the operation (June 21, 1928), the voice was perfectly normal and the laryngologist reported normal cords.

CASE 11. This patient was operated in December, 1916 for an exophthalmic goiter. She was reoperated upon September 18, 1924 because of a return of hyperthyroidism. The operation was extremely difficult, the post-operative course was extremely stormy and was associated with marked hoarseness and inspiratory difficulty. Two days later (September 20, 1924) considerable serum was evacuated with marked relief. An examination of the larynx revealed the left cord in abduction. The respiratory embarrassment as well as the voice gradually improved. An examination of the larynx 2 years later (October 24, 1926) showed actively moving cords.

CASE 12. This patient was operated January 13, 1928 for exophthalmic goiter. The gland was extremely friable and was delivered with difficulty. There was considerable bleeding and while clamping a spurting vessel on the left side near the trachea there was noted immediately a change in the patient's voice. The operation was com-

pleted, and an examination of the larynx revealed a paralysis of the left cord. Seven months later (August 7, 1928) although the voice had improved considerably there was still a paralysis of the cord. On March 19, 1929, 13 months after the operation the laryngologist reported both cords normal.

Here undoubtedly was a paralysis resulting from the crushing of the nerve while attempting to clamp a bleeding vessel near the trachea, returning to normal thirteen months after the injury.

CASE 13. This patient was operated upon January 16, 1928 for exophthalmic goiter. The voice was normal immediately after the operation and for the next 2 days after which slight hoarseness was noted. An examination of the larynx revealed a paralysis of the left cord. One month later (February 21, 1928) the voice was normal and an examination of the larynx revealed normally functioning vocal cords.

The paralysis in this case was probably due to post-operative edema.

CASE 14. This patient gave a history of hyperthyroidism of 16 years duration. She was operated upon December 17, 1928 without incident, the patient breathing normally, the voice remaining unchanged throughout the operative procedure. Some tracheitis developed shortly after the operation which was considerably relieved by steam inhalations. Three days after the operation the patient became hoarse and an examination of the larynx revealed a paralysis of the right cord. Gradually the voice returned to normal and on October 25, 1929, 10 months after the operation the cord had completely recovered.

Here is a case of temporary paralysis resulting from edema of the tissues after operation. The voice was normal immediately after the operation, and not until the third day after operation did hoarseness develop. A severe tracheitis appearing shortly after the operation further strengthened the hypothesis that the paralysis was the result of edema of the tissues about the nerve.

CASE 15. This patient was operated August 19, 1929 for exophthalmic goiter. The operation was uneventful and several days after operation the patient complained of some hoarseness. An examination of the larynx revealed a paralysis of the left cord. Gradually the voice returned to normal and on November 12, 1929 (3 months later) the voice was normal and the cords were reported normal.

How can temporary or permanent paralysis of the recurrent laryngeal nerves be prevented? No definite rules can be laid down, but certain principles must be adhered to which will tend to minimize injury to these delicate structures.

1. Adequate exposure is of extreme importance. The surgeon should not hesitate to transect the ribbon muscles overlying the thyroid gland whenever there is a question as to the adequacy of the exposure.

2. It is extremely important to minimize the force used in bringing the superior thyroid vessels into view.

3 Resection of the thyroid gland should always begin at its tracheal attachments and progress laterally and downward

4 The posteromesial portion of each lobe must be preserved, and under no circumstances must the lateral wall of the trachea be exposed

5 The anæsthetic is of extreme importance and must be light enough so that the patient can be awake within a few minutes. Ether or chloroform should never be used. Probably the best procedure combines the use of novocain infiltration plus either nitrous oxide or ethylene

6 One lobe at a time should be removed, and while the operator is working in the region of the recurrent laryngeal nerve, the patient should be awake and made to talk

7 Accurate hæmostasis is of extreme importance in thyroid surgery. No patient should be permitted to leave the operating table until the operator is satisfied that he has done everything to prevent a postoperative hæmorrhage. Every patient should be made to cough or strain in order to demonstrate any overlooked open vessels

8 Grabbing of tissue about bleeding points should be avoided. Single bleeding points must be isolated before a hæmostat is applied

9 Rough sponging or pulling should be avoided, thus preventing excessive postoperative œdema

10 Hæmatomata should be recognized and evacuated early

11 Routine pre operative laryngoscopic examination of the vocal cords is advisable, as one cord may be impaired. Such information is of importance to the surgeon, who will be particularly careful to preserve the remaining nerve

CONCLUSION

Temporary paralysis of the recurrent laryngeal nerves is not infrequently encountered. Such a

paralysis may be unilateral or bilateral, and as a rule cannot be differentiated from a permanent paralysis, time alone differentiating the type

Temporary paralysis may come on during the operative procedure, by pinching the nerve with a hæmostat, by stretching the nerve during the mobilization of the gland, or from pressure of the nerve by the finger in attempting to control bleeding. Delayed paralysis may occur as a result of hæmorrhage with pressure on the nerve, from a collection of serum causing pressure, and from œdema of the surrounding tissues resulting from the necessary surgical trauma

Function as a rule is restored after a variable period of time, varying from several weeks to several years depending upon the extent of the trauma

I am indebted to Dr. John Wolfer for permission to use Case 1, and to Dr. H. M. Richter for permission to use Cases 3 to 15 inclusive

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PYO-URETER¹

HOWARD S. JECK, M.D. I.A.C.S. NEW YORK

Urologist St. Mark's Hospital and Assistant Visiting Surgeon Department of Urology Bellevue Hospital

AT the 1910 meeting of the American Association of Genito-Urinary Surgeons, Fowler presented an article entitled "Uropyo nephrosis of Only Remaining Kidney, Nephrectomy Pyoureter of Other Side with Peristaltic Contractions of the Ureter Observed Three Years After Complete Nephrectomy."

In recently reading over his very excellent and interesting case report together with the copious discussion which followed, I was quite impressed by the fact that the discussion centered almost entirely on the first part of the title. Much was said about the difficulties of operating on a single kidney but comparatively little on the then unusual phenomenon of observed peristaltic contractions of the ureteral stump and the importance that it might play in the prognosis of the case.

So far as I have been able to ascertain Fowler's was the first article of its kind to be written in this country and the fact that up to this time very little on the subject had appeared in the literature of any country, probably accounts for the trend of the discussion of Fowler's presentation. Since then it has become a generally accepted fact, due doubtless to the experimental work of Latchem and the clinical observations of several others, that peristaltic contractions do take place in certain ureteral stumps notably those containing calculi, pus or both and that such pathological rests may constitute a menace to the patient's welfare.

According to Fronstein, these rhythmical peristaltic contractions depend in part upon the presence of nerve centers which are situated either in the ureteral walls or in the surrounding connective tissue. According to Latchem, the peristaltic movements will cease when there is nothing within the ureteral lumen such as urine, pus, or stones to stimulate the nervous mechanism to action. This explains Latchem's further experimental observation that the muscular coat of the ureter hypertrophies in the presence of complete obstruction and atrophies in the ureter wherein drainage is more or less free.

Latchem's experiments also showed that there is little or no absorption of the contents of a distended ureter.

We have briefly therefore according to Fronstein and Latchem, the physiological reason for the development of an empyema of the ureteral

stump. Given an infected ureter the corresponding kidney of which has been removed, whether or not the stump will become a pus pocket depends chiefly on two factors: (1) the presence of some obstruction, such as stone, stricture or kink, (2) injury to the nerve supply of the ureter, either by operative trauma or peri ureteritis and consequent scar formation. When obstruction occurs, either complete or sometimes partial, dilatation and retention of pus in varying amounts are likely to ensue. When the nerve supply has been damaged, especially in a peri ureteritis, narrowings and pockets are likely to develop due to loss of tone on the one hand and cicatricial contractions on the other.

The greatly distended ureter, present prior to nephrectomy, is of course always a potential source of pyo ureter. But fortunately in a ureter which is anything like normal, the suppurative condition which as a rule follows a suppurative condition of the kidney, usually disappears after the removal of the diseased kidney. This is in accord with Lorin's view who says that if there is a free outlet, pus will usually drain out regardless of extensive damage to the ureter.

Stone is the chief etiological factor by far in the majority of the reported cases of non tuberculous pyo ureter.

Israel, who was among the first to describe the subject, collected 4 cases in 900 nephrectomies. Fronstein saw 3 during 20 years of active practice. Two of his cases were attributed to stricture and one to stone. In one of his stricture cases there were 2 ureteral stumps, both of which he removed. One stump was 3 centimeters wide while the other was not enlarged.

In his very recent comprehensive article on the subject, Hunt reports one case of non tuberculous pyo ureter due to stricture and states that it is the only one he could find in a careful search of the records of the Mayo Clinic, in which ureterectomy was necessary subsequent to nephrectomy for pyonephrosis. He reports 4 other interesting cases due to stone, in one of which ureterolithotomy alone brought about a successful outcome. In the 3 other cases, ureterectomy, either partial or complete, was done.

In this same report, Hunt's figures referable to the tuberculous type of pyo ureter are illuminating. He states "In no instance in the series

¹Read at a meeting of the American Association of Genito-Urinary Surgeons at Trench Lick Springs Indiana May 22, 23 and 24 1910.

of approximately 574 cases in which nephrectomy was performed for renal tuberculosis during the years 1919 to 1928 inclusive, have I found subsequent ureterectomy recorded "

Hyman has reported 3 cases in which empyema occurred in the short remaining stumps following incomplete ureterectomy. Stone was responsible for one of these cases.

Read's case, likewise a recent one, was unique in that the empyema occurred in a ureter which had been transplanted into the bladder. Before the nephrectomy, the underlying cause of the pyuria, namely, stricture at the site of the transplantation, had begun to manifest itself.

Roedelius has reported 2 cases, one due to stone and the other to stricture.

Among other observers who have reported at least one case are the following (the etiological factor is placed in parentheses): Latchem (stone), Chabanolle (stone), Brongersma (stone), Enderlen (stricture), Bruett (stricture) and Klika (stone). In Klika's case, there were three stones in the lower end of the ureter and a groove running along the mesial side of them, through which the urine had evidently passed prior to nephrectomy.

It is noteworthy that in some of the foregoing cases, long periods of time elapsed between the nephrectomy and the development of symptoms leading to the diagnosis of pyo ureter. Thus in the stone case of Brongersma, 23 years intervened and in the stricture case of Roedelius, 17 years. In the majority of the cases, however, 1 to 3 years was the interval.

Among the shortest intervals between nephrectomy and the appearance of symptoms indicative of pyo ureter are those of Klika (6 weeks), one of Hunt's stone cases (6 weeks), Read's case (2 months) and Cases 3, 4, and 5 following.

The probable chief factors upon which this interval depends are the type of obstruction, the degree of infection, the amount of damage to the ureter prior to nephrectomy and the personal equation of the patient.

The principles employed in the successful treatment of pyo-ureter are directed toward

- 1 The eradication of the pus pocket (complete or partial ureterectomy),
- 2 Establishment of better drainage (ureterolithotomy for the removal of an obstruction such as stone or enlarging the ureteral orifice by fulguration or the dilating of strictures by bougies),
- 3 The removal of infected ureteral contents by non-operative means (irrigation),
- 4 A combination of (2) and (3).

In the majority of the cases reported as cured, the method employed was ureterectomy, either

complete or partial, the latter having been employed usually when a stone was present and a segment of ureter containing the stone was removed. It would seem from Hyman's experience that complete, instead of partial, removal of the ureter should be done whenever possible.

Ureterolithotomy for stone is sometimes successful, to wit one of Hunt's cases. But despite the good result in this case, he prefers complete ureterectomy.

Doubtless many cases of pyo-ureter could be prevented by proper treatment of the ureter at the time of nephrectomy. While I cannot agree entirely with Hunt, who at the time of nephrectomy makes it a practice in the ureteral stone cases to remove the ureter either entirely or a portion of it containing the stone, still much is to be said in favor of his argument. Against it, of course, is the fact that there are comparatively numerous instances in which stones that are allowed to remain in ureteral stumps do not subsequently cause trouble. But as far as the prophylactic treatment of pyo ureter is concerned, it behooves every surgeon who contemplates removing a non-tuberculous kidney to make, wherever possible, a complete pre-operative study of the ureter as well as the kidney itself. And if confronted by ureteral findings such as stone, stricture in the presence of pus or the dilated atonic type of ureter, the idea of performing ureterectomy at the time of nephrectomy should be given very serious consideration. In this connection it is well to bear in mind that if the patient's condition will permit, ureterectomy done at the time of nephrectomy should ordinarily be much simpler than at a later period when adhesions arising from a peri-ureteritis are prone to be both dense and numerous. This is well shown by the following description of an operation recently performed by my associate, Dr. Keyes. The procedure he employed also illustrates a method of handling a pyo ureter which is well-nigh impossible to remove.

In this patient, a 35 year old colored woman, there were two ureters. One, draining the upper portion of the kidney which was a pyonephrotic sac, proved to be a widely dilated pyo ureter. The other ureter drained the lower portion of the kidney which appeared to be relatively normal. "The nephrectomy was uncomplicated excepting that the widely dilated pyo-ureter was so adherent at the pelvic brim and so tense with pus that it seemed wiser to bring it to the skin for drainage rather than to attempt a complete ureterectomy and with the realization that a secondary operation would be needed. This secondary operation was performed 2 weeks after the first one. The pelvic ureter was exposed extraperitoneally but everything was so densely adherent in the right side of the pelvis that it was necessary first to open the peritoneum and remove

the adherent tube and ovary on that side, then to lift up the peritoneum from the posterior pelvic wall mesial to the ureter and close the peritoneum.

It was then found that the ureter was a dilated and convoluted tube set in a mass of dense adhesions. At no place could a line of cleavage be found. It was deemed unsafe to attempt complete ureterectomy so the mass of adhesions was split open and the incision carried into the coils of ureter from which thick, sinking pus escaped (bacillus pyocyaneus). Even excision of the mucosa was found impracticable so the whole interior of the ureter was well cauterized with the high frequency current. A No. 22 I urethral catheter sutured into the lowest loop right against the bladder and another tube inserted above.

The accessory ureter was not looked for or discovered. After operation drainage was extremely profuse. Potassium permanganate irrigations were done at first every hour during the day and finally the patient left the hospital with a small tube 1 month after operation. Curiously enough the only postoperative complication was the distress she suffered from the pressure of one of the silk-worm skin sutures.

Up to the time of leaving the hospital it was impracticable to use Dakin's solution for irrigation because the solution caused bladder irritation. It is hoped that Dakin's solution may shortly be practicable and may occasion the healing of the wound.

While the purpose of this paper is to deal chiefly with the non tuberculous pyo ureter reference is made to the tuberculous type merely to emphasize again its relative scarcity.

Approximately 222 nephrectomies have been performed on the Bellevue Urological Service during the years 1916 to 1919 inclusive. This particular interval was chosen because 1916 represents the beginning of the present Urological Service, that is, the time when the individual urological services of the four different divisions of the hospital were consolidated. The total number represents all the nephrectomies performed during this period for whatever purpose nephrectomy was indicated. Of the 222 nephrectomies tuberculosis was the etiological factor in about 98 cases. Of this number 1 subsequent ureterectomy was performed in only one and even in this instance the operation was probably needless as will be shown in Case 1. The tuberculous cases reported herewith illustrate the fate of the ureter which remains after the removal of a tuberculous kidney and are in accord with the usual observations namely that such a ureter takes care of itself and gives rise to trouble only in rare instances. Legueu, while performing a hysterectomy 3 years after a nephrectomy for tuberculosis, found the ureter to be a dense sclerotic cord. Lorin, in examining a series of patients wherein the postoperative course was longer, found obliteration of the ureter.

CASE 1. The tuberculous right kidney of a 15 year old Italian girl was removed in Bellevue March 29, 1920. Her pre operative symptoms of dysuria instead of be-

coming better became steadily worse despite various bladder treatments. Several cystoscopic examinations made at intervals of 1 to 6 months all showed marked inflammation and edema in the region of the right ureteral orifice. Finally ureterectomy was decided upon as a possible means of relieving the patient. This was done on February 24, 1927. The patient was not relieved however until the other ureter was transplanted into the bowel (May 21, 1929). This was undertaken in the full realization that it was a hazardous procedure but the patient was becoming desperate. The transplant accomplished results. Since this operation the patient has put on weight, is in fine spirits and of course no longer suffers from dysuria.

Apparently the only good that came of removing the ureteral stump was to show the operator what usually happens in such a case. I *ery hard and as large as one's thumb at the time of nephrectomy, the ureter had now dwindled down to the size of a lead pencil.* When split longitudinally, the wall had a grayish sceleromatous appearance which in places was yellowish. No muscle tissue could be recognized. The pathologist's report was tuberculous ureteritis.

The data for the second case was kindly furnished to me by my colleague Dr. A. R. Stevens from his private practice. The findings in so far as the tuberculous ureter was concerned were similar to those of Case 1.

CASE 2. It was found during the postoperative course of a 13 year-old boy on whom he had performed a suprapubic cystostomy for calculi and a little later a perineal section for an abscess behind the bladder, that the left kidney was also probably the seat of trouble. A left nephrectomy was performed and the kidney shown to be tuberculous. The ureter was as large as one's little finger and stony hard but no attempt was made to remove it on account of the patient's weakened condition.

Seven months after the nephrectomy, it was decided to do a ureterectomy because it was thought that the kidney and bladder wound which had not yet healed would be favorably influenced thereby. On performing the ureterectomy the operator was surprised to find the ureter *soft and pliable and about the size of a lead pencil.* The patient remained in the hospital for over a year but ultimately the perineal and kidney wounds healed entirely. The suprapubic wound did not fare quite so well although when the patient was last seen in 1919 he reported that it remained closed most of the time.

Of the remaining non tuberculous nephrectomies, approximately 124, a record of subsequent removal of the ureter on account of symptoms referable to it could be found in only 2 of them. However, it should be mentioned that in recently discussing the incidence of the Bellevue pyo ureter cases with Dr. Keyes, he told me he had seen in another clinic, a man whose kidney had been removed at Bellevue. This patient was between 20 and 30 years of age and while the nephrectomy had been performed more than a year previously, he was still suffering from the

same symptoms for which his kidney had been removed. Examination revealed a dilated ureteral stump.

If this he added to the 2 other Bellevue cases, it makes the Bellevue incidence somewhat higher than that reported from other clinics with the possible exception of the cases reported by Hunt.

The following cases of non-tuberculous pyo-ureter are typical and illustrate points brought out in the foregoing. Two of them were due to stones and one to a narrowing of the lower end of the ureter.

Case 3 illustrates the difficulty in attempting to single out the type of ureteral stone which will not give rise to trouble following nephrectomy. It shows also how brief may be the interval between nephrectomy and the appearance of the pyo-ureter. It is of further interest because there was a "Y" ureter, one branch only of which (the one containing the stones) was dilated but both branches of which were the seat of a definite ureteritis cystica. While, strictly speaking, the operation performed was a partial ureterectomy, so little of the ureter was left (not over 15 centimeters) that the procedure could almost be classed as a complete ureterectomy.

CASE 3. This patient E. B., admitted to the Urological Service of Bellevue Hospital, April 1, 1926, complained of pain in the right loin. For 19 years he had experienced intermittent burning on urination. While in the army in 1919 a diagnosis of renal calculus of the right kidney was made. Nephrotomy was performed but no stone was found. About three months after that, however, he passed a stone about the size of a pea. Since that time that is since 1919 his burning on urination persisted and he had attacks of pain in the right loin radiating down to the right testicle. He has not suffered from increased frequency of urination. He brought with him to the hospital a very good X-ray film showing a fairly large calculus which appeared to be in the pelvis of the right kidney and several small calculi apparently in the right ureter low down.

Catheterized ureteral specimens showed the function of the right kidney to be very poor as evidenced by the indigocarmin and urea tests. The function of the left kidney was apparently excellent as evinced by the same two methods.

It was decided that the best plan of operative procedure would be first to remove the stone from the right kidney and then at the same sitting to remove the ureteral calculi through a Gibson incision. Provided the kidney operation had not taken too long, and the patient's condition would warrant proceeding with the ureterotomy.

On April 6, 5 days after admission, the right kidney was exposed by means of the usual oblique loin incision. Something to our surprise the kidney was found to be less than half the normal size and the remaining parenchyma was almost nil. The kidney stone and all, was removed with out any further investigation. An interesting feature of this operation was the finding of a structure which resembled a supernumerary ureter but it was so tangled up in a mass of adhesions that it was almost impossible to identify the structure with certainty.

Since the kidney itself had been removed instead of the kidney stone only, as at first intended, the plan of removing the ureteral calculi was abandoned. *It was argued they would probably never give rise to further trouble and that the patient could therefore be spared the necessity of an additional operation.*

The patient made an uneventful recovery and was discharged from the hospital on April 29, 1926, in excellent condition and with no urinary symptoms. But realizing the possibility of further trouble, he was advised to report back to the hospital should any of his old symptoms return.

On July 8, scarcely more than 2 months after his discharge, he was re-admitted to the Urological Service with symptoms of marked dysuria. He stated that he had been free from urinary symptoms for 1 month after leaving the hospital but since then had suffered from very marked increased frequency of urination, voiding every half hour by day and once or twice at night with considerable pain and burning. These symptoms had become much aggravated about 10 days before his re-admission.

The patient was cystoscoped by the resident urologist, who passed a radiographic catheter up the stump of the right ureter. The resulting X-ray did not prove to our entire satisfaction that the shadows noted in the lower ureteral region at the time of his previous sojourn in the hospital were shadows of calculi. There was too much space between the supposed stone shadows and the catheter shadow.

In reading over the account of his previous operation at Bellevue it was noted that there was some question as to the presence of a double ureter on this side. A few days later, with this in mind, the patient was again cystoscoped and a diligent search for a second ureteral orifice was made but none found. Remembering the possibility of a Y shaped ureter with the bifurcation low down, two radiographic catheters were passed into the only ureteral orifice which could be found hoping that if such a condition existed each catheter might find its way into a separate branch of the Y. The X-ray film with these catheters in place was not particularly useful in proving our point and it was not until an X-ray film was made after sodium iodide was injected up both catheters that it was believed we were dealing with a dilated ureter containing calculi and possibly a second ureter.

While the patient was still on the cystoscopic table a sterile solution of indigocarmin was injected up one of the catheters and immediately quite a quantity of fairly thick pus was seen to exude from the ureteral orifice alongside of the catheter. The specimen collected from the left kidney showed it to be in apparently very good condition.

A diagnosis of pyo-ureter of the remaining stump with the probable presence of ureteral calculi was made and operation again decided upon. On July 13, 1926 through a Gibson incision we found the remains of a Y shaped ureter with the bifurcation, as near as we could tell within one inch of the bladder. In one branch of the Y were three stones corresponding to the shadows seen in the plates. The operation presented no especial difficulties. Both ureters were removed to a point just below the bifurcation. This left only about 15 centimeters of the single stump. The patient again made an uneventful recovery and left the hospital about 4 weeks later with none of the symptoms which he presented on admission. He was last seen about a year after his second operation and reported no return of symptoms up to that time.

The next case (4) was treated by means of partial ureterectomy. The portion of the ureter resected included the cause of obstruction, namely,

a large stone. While the immediate result was satisfactory, we were unfortunately left in some doubt as to the final outcome.

CASE 4. On March 20, 1921, A. M. was admitted to one of the general surgical services of Bellevue Hospital soon after he had been caught between the radiator of one automobile and the rear end of another which was backing. A left pyonephrosis developed and the kidney was removed May 21, 1921. He was discharged on July 12, 1921, and re-admitted June 6, 1922 (this time to the Urological Service) on account of severe pain in the left inguinal region which radiated down to the penis. A considerable amount of pus was found in the bladder urine. Cystoscopy revealed normal urine from the right kidney and a catheter could be introduced up the left ureter for only 1 centimeter. Nothing was obtained through the catheter and nothing was seen to emanate from the ureteral orifice. The bladder mucosa appeared to be perfectly normal and this fact coupled with the finding of pus in the bladder urine and normal urine from the right kidney, led to the conclusion that the pus probably came from the left ureteral stump. However, since his symptoms disappeared soon after the cystoscopy the patient was discharged on June 25, 1922.

On July 17, 1922, he was re-admitted again for pain in the left lower quadrant and an X-ray film showed a stone measuring 2 by 5 centimeters near the lower end of the left ureter but his symptoms again disappeared and he was discharged at his own risk.

On August 4, 1922, the patient was admitted for the fourth consecutive time to Bellevue. On this occasion the pain in his left loin and left lower quadrant was so severe that he did not hesitate to agree to an operation. His only other symptoms were increased frequency of urination.

On August 23, the following day, through a somewhat modified Gibson incision the left ureter was exposed. It was found to be about 3 centimeters in diameter. A stone about the size of one's thumb was removed from a point in the ureter a little above the bifurcation of the iliac vessels. Just above the stone was a walled off abscess within the ureter containing about 10 cubic centimeters of thin milky pus. This was accidentally ruptured and the part of the ureter which had contained the abscess and the part containing the stone a segment in all of about 10 centimeter was removed. More of the ureter would have been removed except for the dense adhesions between it and the peritoneum which was torn once during the procedure just described. A large cigarette drain was placed at both the upper and lower angles of the wound with a large rubber tube drain leading down to the region of the pus.

The patient was not discharged from the hospital until October 23, 1922, at which time there were two sinuses, one in the old nephrectomy scar and another in the left lower quadrant. At his only recorded visit to our return clinic, on November 2, 1922, there was still a small sinus in his loin with a larger sinus in the left iliac region. Both wounds were clean but gave rise to a slight discharge. His general condition however was excellent.

I am again indebted to Dr. E. L. Keyes for another case (5) which illustrates that may be accomplished by the non operative treatment of pyo-ureter due to stricture.

CASE 5. H. B., 21 years old according to an X-ray film had stones in both kidneys. On May 14, 1921, one large and several small stones were removed from the right kidney. Two weeks later the left loin became pain-

ful and tender with an increase in temperature. The left kidney, very adherent and full of thick pus was removed. No stones either in the kidney or its ureter were found.

The patient left the hospital 3 weeks after the last operation but from that time until comparatively recently has experienced more or less trouble referable to the urinary tract. At first there were pains without fever, in both loins. The right sided pain was due to a stone (shown by X-ray film) in the right ureter. This stone was finally passed in October, 1921, and relief experienced. However catheterizations and dilatations of the right ureter were subsequently necessary before her right side ceased giving symptoms.

The pain in her left loin was shown by cystoscopy to be due to a pyo-ureter. Great gobs of pus were found in the bladder, while urine from the right ureter was clear. Washings of the left ureteral stump (the capacity of which was about 10 cubic centimeters) confirmed this and while relief always followed irrigations of the left ureter, the loin pain though becoming less severe returned with regularity. The pain usually lasted 2 to 3 days and occurred every 2 to 3 months. The pus in the bladder had diminished appreciably.

In 1925 as a result of more left sided colics the left ureter was again irrigated and its orifice enlarged by electrocauterization. Irrigations of the left ureter were continued at longer and longer intervals, until finally in November, 1925, she presented none of her old symptoms and her urine showed no pus.

While she has had another right sided colic (probably due to a kink) as recently as January, 1930, her left ureter has given her no further trouble. She feels well, has put on 20 pounds in weight and her urine sparkles.

Both Roedelius and Bruett have reported treating cases of pyo-ureter by irrigation alone.

Case 6 is appended merely to show how chronic prostatitis may simulate pyo-ureter.

CASE 6. A. Z., male, aged 31 years entered Bellevue Hospital in June, 1919, with stones in both kidneys. The larger stones were in the left kidney pelvis. On the right side one stone was stuck in the upper ureter. The right loin was accordingly opened. His kidney is quite adherent, the pelvis distended and a triangular oxalate stone fixed in the upper end of the ureter about 3 centimeters from the kidney pelvis. One small stone was found in the kidney pelvis and one in a middle calyx. The convalescence was stormy, but when he left the hospital 8 weeks after the operation the phenolsulphonethylamine output was 55 per cent in the first hour after intramuscular injection and he was so well that he refused operation upon his left kidney until October, 1925. A calculus pyonephrosis was removed and his convalescence, except for an epididymitis was uneventful.

Three weeks after nephrectomy he passed a considerable amount of thick pus in the urine. Three days later the urine was grossly clear and the left ureter was catheterized the catheter stopping at 22 centimeters. Two cubic centimeters of 1 per cent mercurochrome was injected into the ureter. This catheterization was repeated five times during the next 4 months. On three of these occasions 1,000 silver nitrate solution was injected. The urine from the right kidney pelvis never contained any pus. He was having discharges of creamy pus about once in 6 weeks regardless of the injections. (No accumulated fluid was ever drained from the ureter when the catheter was introduced.) In May, 1926, 7 months after nephrectomy, the pyuria became rather more continuous and was attacked

for the first time by prostatic massage. This promptly diminished the output of pus. Prostatic massage was continued for 1 year before the pyuria permanently cleared up. The patient was last seen in July, 1929, with only a few pus cells in the urine and no symptoms.

SUMMARY AND CONCLUSIONS

1. Pyo-ureter is caused chiefly by two factors (a) obstruction, and (b) injury to the nerve supply of the ureter resulting in absence of peristalsis and lack of tone.

2. The chief etiological factor in most cases of pyo ureter is ureteral stone.

3. While the relative occurrence of pyo ureter, including even the stone cases, is small, it is a definite menace to life. More attention therefore should be directed toward its prevention. This can be best accomplished by proper treatment of the ureter and its contents at the time of nephrectomy which presupposes a careful study of the ureter prior to nephrectomy.

4. While a few cases may be successfully treated by non-operative measures, such as fulguration and irrigation, ureterectomy, especially complete ureterectomy, is indicated in the great majority of cases.

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VARICOSE ULCERS

TREATMENT WITH "THE RUBBER SPONGE OR VENOUS HEART" AND SUPPORTIVE BANDAGE¹

H. D. McPHEETERS, M.D., F.A.C.S., AND CHARLES F. MERAERT, M.D. MINNEAPOLIS, MINNESOTA

CHRONIC ulcers of the lower leg, like all ulcers of the body, are produced and maintained by malignancy, trauma, infection, circulatory changes, or combinations of these factors.

Ulcers due to malignancy are quite rare and are characterized by an indurated edge, lack of inflammatory changes, progression in spite of treatment, and positive biopsy findings by means of which they may be recognized.

Certain ulcers caused and maintained by specific infections such as syphilis, tuberculosis, and actinomycosis also have characteristics by which they may be recognized and diagnosis may be confirmed by blood tests and microscopic examinations of the tissue or curettings.

Buerger's and Raynaud's diseases, by narrowing of the terminal arteries, produce a decrease in the arterial blood supply to the extremity and very often produce a state of dry gangrene or chronic ulceration as a direct result. However, ulcers due to these two conditions most often affect the toes and feet. In one case with varices size three in the thigh and size two scattered widely over the lower leg with an ulcer dollar size internal to the ankle there was a marked Raynaud's disease present. This involved both the feet and hands. The case has since had a sympathectomy on both lumbar and cervical segments with much relief, a fact which would prove the diagnosis.

Very often elderly patients with arteriosclerotic conditions of the terminal arteries present themselves due either to the pain and ache in the lower legs, or to the ulcerations and gangrene which develop as the end result. Oftentimes they will have varices associated and may have trophic ulcers present, yet the arteriosclerotic condition is the predominant and newly developed factor.

Leaving out the already described types of ulcer of the lower leg which have all had a well defined etiology, we are left with that vast majority of

ulcers which may or may not have had trauma as an originating cause but the continuance of which must be due either to less specific types of infection or to factors of circulation other than Buerger's or Raynaud's disease. If they are associated with demonstrable varices they are called varicose ulcers.

All varicose ulcers should be subdivided into three groups:

1 Those which respond to treatment and heal rapidly.

2 Those which have in reality become trophic ulcers with such a lowered state of vitality and scar tissue formation that they do not seem to heal yet do not have any marked degree of edema present.

3 Those that exist due to lymphatic blockage following repeated attacks of thrombophlebitis and cellulitis.

The two latter groups are in reality no longer varicose ulcers but trophic states existing as the end result of the long continued infection.

Loewenfeld has studied the bacteria in chronic varicose ulcers of the leg. He has found that the infections in these ulcers usually hold a veritable menagerie of bacteria, the most common of which were staphylococcus, streptococcus, pneumococcus, and colon bacillus. He stated that no organism may be held as a specific cause and that the germs present had little to do with the lack of healing (read Lewis Circular).

Nobl stated that he never had the impression that recovery was in any way due to greater or less aggregation of germs. The truth of these opinions is well proved by the multiplicity of antiseptics and chemical tissue stimulants that have been used in the treatment of these ulcers in the past, always with but slight or unsatisfactory results as far as production and maintenance of healing is concerned. Loewenfeld also stated that those ulcers which heal most rapidly often contain the most bacteria.

What then is the reason for the inability of the body to heal this vast majority of leg ulcers?

Delbet and Mocquet, of Paris, stated that varicose veins were produced by progressive breaking down of valves in the external saphenous veins beginning at the main valve at the saphenofemoral junction, allowing a reflux flow and alter

¹ The author is collecting statistics relative to fatalities associated with the injection treatment of varicose veins. He would consider it a great courtesy to both himself and the profession in general if any and all physicians having information relative to such fatalities would kindly communicate with him with as much detail as regards the case as possible. It is only by means of such co-operation that accurate and complete statistics can be obtained.

It has often been stated that physicians have refused or neglected to report such cases through fear of criticism. Such fears are groundless inasmuch as no names of either doctor or patient will be mentioned except at the request of the physician in charge.

nate dilatation of the saphenous branches. This mechanism as the whole cause of the production of varices has been disputed. However, in the more advanced stages of varicose veins there is no question as to the truth of the mechanics of flow as pointed out by their papers. Trendelenburg, in 1890, wrote a classical paper on this condition and his methods and conclusions still stand accepted today. The Trendelenburg test is still the commonly accepted method of determining this point as to the reflux flow. It has been beautifully demonstrated by the injection of lipiodol and direct observation under the fluoroscope as published by one of us in a recent article. The mechanics as described can be best shown by a diagram (Fig. 1). This shows progressive breaking down of valves with ultimate vicious circle of blood flow.

The pressure of blood in the veins of the lower leg in the varicose condition has been measured and found markedly increased. Delbet, von Meisen, and others have reported it at 26 millimeters of mercury. We have checked this repeatedly and have found it to average 88 millimeters of mercury in the extensive cases of varices of the calf. This increase of reverse pressure eventually causes a separation or widening of the spaces between the cells of the terminal capillaries and allows the blood plasma to be forced outward into the tissues, producing edema. This reflux flow extending out into the tissues not only waterlogs the tissue, stretching fibers and cells apart, but also keeps the tissue cells surrounded by a serum poorly oxygenated, lacking in food, and saturated with lactic acid and other products of combustion which, if not eliminated, tend to produce acidosis. Due to this tissue congestion and saturation with serum and to the secondary infection which develops, there is a marked lymphatic stasis locally as well as at times in the area below the ulceration. This is best explained by a mechanical strangulation or blocking of the lymphatic channels and ducts by the induration of the tissues which develops. The experimental work of Homans, of Boston, makes this most clear and Trout¹ has gone into this phase of the pathology very much in detail in his last article (Fig. 1). Is it any wonder that slight trauma or hematogenous infection can easily produce an ulcer in these tissues and that when an ulcer is present that it shows little tendency to spontaneous healing?

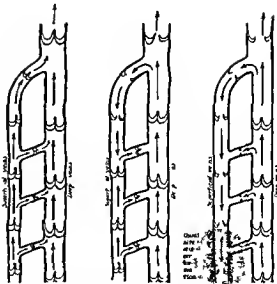


Fig. 1 Graphic illustration of direction of venous flow in the superficial and deep veins both in the normal state and in the case of extensive varicose veins with ulcer formation.

Closely related to the ulcer, often underlying or running about its margin, one may find one or more large varices (Fig. 2). Payne has called these associated varicosities "stagnating, stinking sewers, inundating an adjacent field and rendering it barren."

The actual ulceration begins with a gangrene and separation of the superficial layers of the skin, secondary infection soon takes place and may produce changes giving the ulcer the appearance of a carbuncle with raised, indurated margins and a sloughing base. There is a general cellulitis present in the tissues locally. Ulcers in this stage are very painful. Later the ulcerations may extend through all the dermal layers and even further, so that at times when the ulcer is over the tibia we may have a marked periosteitis complicating and giving a very painful condition. In some cases a weeping eczema of the surrounding skin and even of the whole leg may be present. There is some evidence of attempts at spontaneous healing in many ulcers but this is expressed usually in more recent ulcers by pale hydropic granulations of the ulcer base. In the deep ulcers peroneal thickenings and bony spicules may be present. In some cases of long standing the whole lower one half of the lower leg may be involved in a fibrotic process and be hard and board-like.

It is our opinion that the mechanism of reflux flow, with increased downward venous pressure and the consequent waterlogging of tissues with stagnant serum is the prime cause for these destructive and abortive healing processes though trauma to this lowered area of vitality is usually

¹ Though the authors do not agree with Dr. Trout in his radical work except for a much more restricted type of ulcer yet they believe he has presented one of the best papers on the subject in recent years. He has given a thorough résumé of the literature citing many authorities on all phases of the work. His bibliography is unusually complete and thorough.



Fig 2 Association of the varicose vein with the ulcers

the active cause of the terminal breakdown and ulceration. Any logical method of treatment must be aimed at correction of this abnormal flow. Removal of the main saphenous varices, thus stopping the main reflux flow of blood, can be accomplished by three methods:

1 Surgical removal as practiced in the past by one of the many accepted methods

2 Surgical removal plus injection—practiced by comparatively few men

3 Injection treatment with sclerosing solutions. This is now accepted as the only justifiable method

Destruction of reflux venous flow, however except in some of the more superficial and recent ulcers, is not sufficient to produce healing. One must also in some way remove the inundating stagnant serum and lymph from the tissues and at the same time enhance the opportunity of the tissues to receive a more constant supply of arterial blood with its revitalizing properties.

A number of measures producing compression and support to the tissues have been used both here and abroad for many years. Most of them had been used before the injection treatment had become popular. The most commonly used are as follows: (1) rubber stocking, (2) elastic stocking, (3) Unna's cast, (4) Zedeno's bands, (5) Boynton's adhesive—(a) just over ulcer, (b) toes to knee, (6) gauze pad with elastic bandage, (7) rubber sponge with elastic bandage.

Favorable results are reported in the use of each and all of these methods of treating varicose ulcers and in our own work we have adopted and used the last named method, inasmuch as it is the most effective one to remove edema, to aid blood supply to the tissues, and thus to promote healing. The Unna's cast is reserved for use when continued support is desired after the ulcers have

healed. This is about the only place in which it is used today. In its place we may use any one of the bandages if preferred.

In our use of the rubber sponge we feel that we have gone a step farther than Professor G. Nobl, who first introduced its use in the treatment of ulcers. It is true, as explained by Nobl, that mere compression will aid in forcing the blood serum and lymph from the tissues and at the same time compress the coarse hydropic granulations that overgrow and literally smother and choke out the normal epithelial cells which attempt to spread over the ulcerations. Compression, however, is not enough. We have found that one more measure is necessary to get the best results. After the sponge is bound in place very tightly with an Ace bandage if the patient does not walk, he will suffer a great deal of pain and often demand the removal of the sponge and bandage or even remove it himself on account of the severe pain. If, however, the same patient is impressed by his doctor of the advisability and necessity of doing a great deal of walking with the sponge and bandage applied as above directed, instead of having pain he will find that the pain and soreness in the ulcer area rapidly disappear. Not only will the soreness disappear but active exercise of his legs gives other important results.

In the title of this paper we have called the rubber sponge "the rubber heart." During the walking that we are emphasizing we feel that the sponge acts very much in the way of a heart, not only passively compressing tissues but with each systole of the sponge actually actively pumping serum, lymph, and venous blood from the tissues and small blood vessels and allowing with each



Fig 3 Typical varicose ulcer. Eight years duration. Same leg months later after treatment with rubber sponge, Ace bandage and usual dressings.

sponge diastole a fresh flow of arterial blood into these vessels and tissues. Thus the sponge gives a soft, gentle massage to the tissues when the patient is walking. We explain the pumping action as follows: Each time a patient takes a step his calf muscles, while contracting, bunch up momentarily, giving a tug on the Ace bandage which is passed on to the rubber sponge. This produces active compressive action of the sponge which alternates with a comparative relaxation period when the calf muscles relax. Firm pressure is maintained all the time, however, though intermittently increased. The truth of this mechanism can be easily proved if one feels of the rubber sponge while the patient is walking.

It is more clearly and graphically shown when the rubber cuff of a blood pressure manometer is placed over the ulcer or calf and bandaged with the 4 inch Ace bandage. The bag should be inflated to the size of a rubber sponge actually used in treatment. When the bandage is wrapped firmly, as in a case with much oedema and infection, the manometer will show a pressure of about 80 millimeters of mercury. When the patient stands and shifts the weight of the body back and forth, first on one foot and then on the other, the reading of the manometer will vary 80 to 100 millimeters with each firm contraction of the calf muscles. This increase of pressure each time, is passed on to the tissues beneath, thus giving the massage or pumping effect. This being the case the rubber sponge can rightfully be called a "rubber or venous heart." The tightly wrapped, semi-elastic Ace bandage gives steady compression on the leg generally and overcomes the reflux flow and lymph stagnation. The superfluous fluid is thus forced from the tissues and pumped up and out of the leg.

The theory of the treatment rests on the belief that the patient's heart will pump fresh arterial blood filled with oxygen and tissue food to the extremity and ulceration, but that we must aid the circulation to carry off the products of combustion and ketosis which cause the local acidosis and tissue death. This is most admirably and efficiently done by a supportive Ace bandage and good grade rubber sponge combined with walking. In other words the patient's heart will pump the arterial blood to the extremity and our rubber or venous heart will pump it back and thus return the vitality of the tissues to their normal state by the rapid and normal interchange of blood constituents.

This method of treatment is so radically different from that practiced in the past that it is hard to convince the patient of its rationale. Often-



Fig 4 left Shows rubber sponges of assorted sizes. The appropriate size selected for this particular case.

Fig 5 Ulcer has been dressed with ointment, and fluffed gauze and sheet wadding has been applied. The appropriate size sponge in place.

times the patient has had several recurrences and each time the doctor has promptly impressed him with the seriousness of the situation and the importance of "bed rest." The patient has usually readily accepted the dictum as his only recourse and has often lain in bed for days, weeks, or months with the legs in elevation to relieve the back pressure of the venous circulation and to allow the effect of gravity to drain off the serum and lymph causing the oedema. With the patient in this helpless situation all sorts of ointments and lotions have been applied and of late years the ultraviolet light has been used a great deal. The latter, the authors believe, has been used more for the psychological effect than for any truly inherent healing value. Each time the legs may or may not have healed but have left the tissues scarred and more subject to another recurrence of the ulcer and more in need of supportive care and treatment than before. Is it any wonder that these patients hesitate to believe the sanity of instructions and treatment when it is so diametrically opposed to that which they have paid good money for in the past? It is thus clear that the patient must be thoroughly "sold" on these modern methods though at times it is certainly a hard and difficult process.

The actual care and treatment of a varicose ulcer with the rubber sponge and Ace bandage is as follows:

1. Cleanse the skin and ulcer area with gauze wet with benzine.
2. Apply 10 per cent silver nitrate to the ulcer. This stimulates but is of no value at the first dressing of a badly infected and necrotic ulcer.
3. Apply some mild ointment to the ulcer area that will remain soft. Many ointments dry and cake.
4. Apply several layers of fluffed gauze.

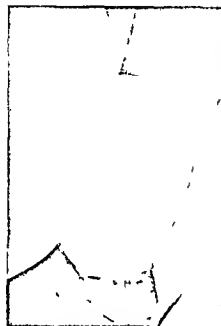


Fig 6

Fig 6. Sponge and dressings bandaged in place with 4 inch plain gauze bandage

Fig 7. Ace bandage (4 inch) being applied from above downward



Fig 7

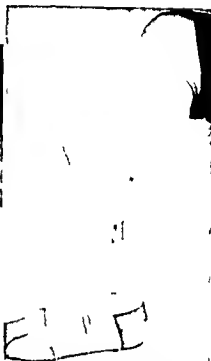


Fig 8

Fig 8. Lower leg completely bandaged with Ace bandage (4 inch) from knee to toes double figure of eight wrapping about ankle and foot. This holds the rubber sponge or venous heart in position over the ulcer which gives the 'pumping effect' on walking.

5 Cover this with 4 layers of sheet wadding or cellucotton

6 Select a good grade rubber bath sponge (firmest possible), that is one inch larger than the ulcerating area

7 Bandage this all in place with a 3 inch plain gauze bandage. Be very careful that the dressing and sponge does not slip to one side

8 Apply a 4 inch Ace bandage from just below the knee to the toes over the sponge and dressing. Bandage firmly. The more cellulitis and the worse the ulceration the tighter the bandage must be applied. Apply it as a double figure of eight about the foot and ankle

9 Sell the patient *completely* as to the point that *the more he walks* with the leg thus bandaged, the *quicker* will the ulcer heal

10 *Never* apply the sponge and bandage described to a bed patient

11 Change the dressings often enough to keep them from becoming saturated. Every 2 days is preferred. The rubber sponge can be *boiled* up and used again when soiled, but should be discarded as soon as it has lost its "kick" and has become firmly pressed together

Observation of an ulcer after a few days use of the sponge and Ace bandage associated with walking will often amaze one with the rapidity with which the old, sloughing or hydropic tissues can be converted into clean, fresh granulations which bleed easily with a bright, fresh arterial type of blood. The secretion from the ulcer surface diminishes rapidly, the cyanosis of the ulcer disappears, the oedema of the surrounding tissues melts away, the tissues become soft and tend to approach the normal. Thus, ideal conditions are maintained for the ulcer healing, the end results are reached in a comparatively short period, and the patient continues on at work during the entire time. Such cannot be said of any other method of treating varicose ulcers today.

Any type of pressure over and about the ulcer will *tend* to approach the method described but so far has proved less efficient. Some men strap wide bands of adhesive about the leg and over the ulcer. This will give local pressure but the case will improve much more rapidly if the rest of the lower leg is supported at the same time. This is more true if there is much cellulitis and oedema

The new Klebro bandage and the Tricoplast bandage both serve admirably for support after the case has healed. They are also fine in cases of eczemas, healed but in need of further support. The former in particular is effective since it will adhere to the skin, does not make the skin sore, can be worn for 4 to 6 weeks at a time, is pliable, and will stretch sufficiently that it can be applied to a funnel shaped thigh or leg. Baths can also be taken with it in place as it is made with a wax base and will not loosen with water.

For those cases needing continuous support, yet who prefer to remove it each night, the Ace elastic or the new B and D silk elastic bandage, or the elastic stockings serve very well.

The authors agree with Drs Homans and Trout that there are ulcers, truly varicose to begin with, but which no longer have any varicose veins present or associated with them. These would correspond to those in groups 2 and 3 in our classification. In most cases these are in reality trophic ulcers and are complicated by the immense amount of scar tissue and lymphatic blockage that has formed by their many recurrences over a period of years. Group 2 is the indolent type persistent at times over the tibia or about the ankle with but little oedema present. This is best treated by excision and skin grafting or by preparing as previously advised (5) and grafted without excision. External support must be continued for a long time after the grafts have healed. Those ulcers in group 3 may be treated by the excision of the ulcer combined with skin grafts and a modified Kondolen operation. This may offer an outlook for a cure and for relief from some type of supportive bandage. In our hands, however, the patients with these extensive and recurrent ulcerations have been so comfortable and

have had so little disability that they much prefer to go on with the continuous supportive care and treatment than to accept the long hospitalization and operation with all the pain and distress it entails. Except in the unusual and rare case we most emphatically disagree with them and are convinced of the superiority of this plan of treatment.

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EDITORIALS

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PEPTIC ULCER

ONE of the hopeful signs of the times is the changed attitude toward each other of the internist and surgeon with regard to the treatment of peptic ulcer. One has but to note the trend in current medical literature on this subject to be struck by the fact that no longer are the leaders in the two main branches of medicine engaged in acrimonious controversy when the subject of peptic ulcer is under discussion. But, on the contrary, one will observe with great satisfaction that the surgeon is now quite willing, indeed anxious, to avail himself of the aid rendered by the internist in matters of diagnosis and treatment, both pre operative and postoperative. The best physicians, in turn, no longer claim to cure peptic ulcer without fail and unaided, but appear quite willing to give their patients the benefit of what well considered and well performed surgery may offer. Thus the avoidance of extravagant and unwarranted claims on the part of overenthusiastic representatives of both branches of medicine, together with the development of closer co operation be-

tween them, will go a long way toward removing the confusion that has resulted in the past in the minds of the average surgeon and the general practitioner, as to the best methods of treatment of this important affection.

Among the factors responsible for this improved condition may be mentioned a more careful and judicious study of the end results in a large number of cases over a sufficiently long period of time, in order to eliminate certain errors inherent in a study limited to insufficient data, and, on the other hand, to arrive at trustworthy conclusions bearing the weight of authority based upon accumulated experience and careful analysis.

A glance at the end results of treatment by either medicine or surgery will show conclusively that it ill becomes either side to boast unduly of its own results, or to criticize harshly those of the other. The percentage of failures reported, even under the most favorable conditions, and by all methods of treatment, are to date far too high to justify over confidence or any relaxation of effort upon the part of the medical profession as a whole, to find a satisfactory solution of the perplexing problems involved, and as yet unsolved. One of the chief causes of delay in finding such a solution heretofore, has been a marked tendency among writers to assume the rôle of advocate rather than that of judge, to make a special plea for some particular form of treatment, rather than an impartial statement of facts, and let them speak for themselves.

A certain diversity of opinion in the matter of treatment is not to be wondered at, indeed, is inevitable, in the consideration of so complex an affection as peptic ulcer, especially so

when one stops to consider that even at this late date its etiology remains unknown and, therefore, methods of treatment, whether medical or surgical, must, of necessity, be largely empirical. This unsatisfactory condition will, in all probability, continue until our knowledge as to the causation of peptic ulcer is more exact. Real progress, therefore, for the present at least, would appear to lie in this direction.

As a matter of interest, if one compares the results as given in the symposium on peptic ulcer at the last meeting of the American Surgical Association¹ with those of equally responsible medical authorities,² one will at once be struck by the fact that for the first year, at least, the difference between them is comparatively slight, but, as time goes on, the percentage of recurrences after medical treatment becomes increasingly more pronounced. This would seem to indicate that medical "cures" are less permanent than surgical.

In this connection, when speaking of "cures," several facts are not infrequently lost sight of, namely, that peptic ulcer is probably of more frequent occurrence than is generally supposed and that, except for the complications—perforation, hemorrhage, malignant degeneration, etc.—that may result therefrom, it does not tend to a fatal termination, but rather to spontaneous cure. The frequency with which evidence of existing or pre-existing ulcer is observed at autopsy, or upon opening the abdomen for other affections, would seem to bear out this statement. In giving credit, then, to any particular method of treatment for an apparent "cure," the *vis medicatrix naturae* cannot be ignored, since it is a matter of common knowledge that ulcer has a strong tendency to heal, or, at any rate, toward remission of active symptoms. This, in turn, is offset by an equally strong tendency toward

recurrence, seasonal or otherwise. All these factors tend to create confusion when one comes to speak of cure.

Therefore, in the discussion of this subject, either with one's patients or fellows, it is well to observe a certain amount of restraint in the matter of sweeping statements unsupported by facts, and the making of extravagant claims that cannot be substantiated by indisputable clinical or pathological evidence. Care should be taken to avoid falling into the error, either of undue optimism, as do some, or of unwarranted pessimism, as do others.

The combined experience of many surgeons and physicians shows conclusively that a large percentage of patients are permanently cured, either by medical treatment alone, or following a surgical operation, and that a smaller percentage are little, if any, benefited by either course, and that the mortality rate after surgical operation, as well as that due to perforation, hemorrhage, etc., after strictly medical treatment, while definite, are not high. The physician or surgeon, therefore, when consulted by a patient with peptic ulcer, is to be justified neither in withholding from his patient the possible benefit from surgery, nor, on the other hand, the rushing him too precipitately into it. Here, as elsewhere, is needed the exercise of that *sine qua non* in good surgery—surgical judgment—with regard to the question as to when to operate, if at all, and what should be the nature of the operation. Among the conclusions that emerge from unbiased discussion of this subject, none stand out more clearly than that surgery should begin where medicine leaves off. In other words every case of peptic ulcer should be given the benefit of the best medical skill available before being subjected to operation.

As to the types of operation to be employed, again it remains for surgical judgment and experience finally to decide. However, caution

¹Ann. Surg., 1910, October.
²Crohn, Affections of the Stomach. Philadelphia: W. B. Saunders Co., 1917.

may well be exercised especially by the inexperienced surgeon, lest he be carried away by the rosy reports of the advocates of the radical resection method. It is a difficult matter to convince conservative surgeons that the indiscriminate use of an operation which sacrifices so great a portion of so vital an organ as the stomach, for so small a lesion as peptic ulcer, which, moreover, is so comparatively innocuous and which tends so strongly to spontaneous cure, is justifiable. Is it quite logical to claim, because the mortality rate is comparatively low and the immediate results apparently good that routine subtotal resection of the stomach is the best operation? May it not rather go to show just how tolerant to punishment the human organism really is? Which is the more logical, to claim that because the Scotch are admittedly a hardy race, and because oatmeal is one of their principal articles of diet, that, therefore, oatmeal is an excellent food, or that the fact that they do thrive on oatmeal simply goes to show just how hardy a race they really are, to be able to flourish upon such a diet?

The improved condition with regard to the general status of peptic ulcer, to which earlier reference has been made, augurs well for a still further advance in the future, if a more judicial approach is had to the study of the problems involved, especially those factors underlying the etiology of the affection, in order that thereby a more rational method of treatment may be developed than the empirical methods now in use. J M T FINNEY

THE RÔLE OF SURGERY IN REDUCING THE COST OF MEDICAL CARE

NOT infrequently arises the cry that too much surgery is being done. Those who raise such a cry probably are excited by finding a patient who

may have been unnecessarily subjected to an operation. Such cases are few, however. It is commoner to see patients who should be operated upon and are not, or patients who are operated upon but only after the hour of grace has passed.

It is said that the death rate from appendicitis is increasing. If this is true one of the causes may be the advent of a generation of doctors who have become overcautious, too timid souls who have been scolded so much about taking out normal appendices that they allow many diseased appendices to remain too long. The same observation applies to the gall bladder, stomach, and other organs.

It can no longer be said that there are surgeons who deliberately operate upon organs which they know to be normal. The day of such men has passed, if there ever was such a day. Certainly the average surgeon who tells his patient that he has cholecystitis or peptic ulcer is honest in his belief, and generally diagnoses the condition correctly. In such cases long experience has shown that cure can be brought about only by surgical means, and patients should be given the advantage of prompt operation.

In untreated surgical conditions or in patients operated upon late, the accumulation of complications not only is responsible for a higher morbidity and mortality rate, but also for great economic loss and a material part of the increase in the cost of medical care. As an example, consider the badly managed case of acute appendicitis in which somebody endeavors to "get the patient by the attack." What happens? The appendix becomes gangrenous or ruptures, peritonitis supervenes, and finally the patient is brought to the hospital as a last resort.

Many such a patient dies in a few days, but if he lives, at what price? By great loss of time and much suffering and expense on

the part of many people, not to speak of the mental and physical strain on the physician and surgeon. Well-timed surgical treatment would have diminished by 75 per cent or more the financial burden and every unhappy accompaniment. And often the story is not finished, when, after many weeks' or months' disability the patient returns to work. A year or more later he may again be brought to the hospital with acute intestinal obstruction, which may cost his life or another long illness with its heartaches and great expense.

The consideration of these every day happenings should not be overlooked by those

who are concerned with the study of the cost of the prevention and cure of disease. One remedy may lie in giving increased attention to the teaching of practical medicine both to undergraduate and graduate students. In our efforts to investigate the new and rare in medicine, are we not apt to neglect the common old things by which we are surrounded constantly, and from which there is no escape?

Untrammelled by ignorance, inexperience, and prejudice, prophylactic surgery is prepared to contribute a significant quota to the reduction of the cost of medical care in all its phases.

FRANK K. BOLAND

MASTER SURGEONS OF AMERICA

MANUEL TOUSSAINT

ONE of the most outstanding figures in the contemporary medical world was Dr Manuel Toussaint. He was a physician endowed with vast knowledge, a wise and experienced clinician, a skilful and careful surgeon, and a gentleman above reproach. In him were thus combined so many excellent qualities that it has been difficult to find anyone to replace him.

Dr Toussaint was born in the city of Puebla in 1866. He began the study of medicine in Puebla but later, in 1884, after an examination at the capital he was given the title of physician and surgeon. He began his professional career by serving in the Military Medical Corps and was commissioned to go to Europe to study hygiene. Eager to learn, he went to Germany and after having fulfilled the object of his commission he took up the study of other branches of medicine, such as bacteriology, histology, and pathological anatomy, which, in those days, were not very far advanced in our country. Under professors of note, such as Virchow and Weigert, Koch, Fraenkel and Petri, he studied these important subjects for three years. He completed his studies abroad by taking courses in surgery under the direction of Bergmann and Kuster and in medicine under Linden and Senator. He then went to France where he pursued his favorite studies further.

He returned to Mexico eager to apply his knowledge. First, he became affiliated with the National Medical Institute, in which he rendered important service in the school of medicine. Here after a competitive examination he taught histology, and had charge of the department of pathological anatomy which was created especially for him. Finally, in the Institute of Pathological Anatomy he did work of great interest which is referred to later.

His work as a surgeon began in the hospital of Jesus of Nazareth, founded by Cortes, and was continued in the Hospital de la Beneficencia Francesa, of which he was director. He was especially interested in surgery of the stomach and bile tract, in which work he acquired great skill.

An old calculus cholecystitis which had seriously affected his liver and for which he was operated upon a little while before his death by one of his pupils, was the cause of the death of this master—a master in the highest sense of the word—in September 4, 1927. He who knew the anatomy of the liver to the



MANUEL TOUSSAINT
1860-1927

most minute detail, he who was master of hepatic pathology and who had removed many lesions of the liver died of the disease of which he had so many times cured others, as if haughty death took this way to avenge himself on his conqueror

The scientific work of Dr Toussaint was concerned particularly with pathological anatomy His study of cirrhosis is worthy of mention, he set forth ideas now accepted by such clinicians as Sergeant but which he propounded many years before He studied the etiology of typhoid and, indeed, ate infected substances to see if they would produce the infection, but fortunately they did not He has published in different medical journals articles on his studies of actinomycosis, rhinoscleroma, intestinal pneumatosis, the cytology of the blood in syphilis and, as well, on many other subjects

He filled many honorary posts and commissions and left in them all indelible traces of his brilliance He was a colonel in the Medical Corps, director of the Institute of Pathological Anatomy of the General Hospital and the Hospital de la Beneficencia Francesa, professor of the school of medicine, doctor of the National University, and member of the University Council, of the Mexican Medical Association and, as well, of various foreign scientific societies

He was a representative of his country at different international congresses, once in Russia and another time in Buenos Aires This enabled him again to visit the principal European medical clinics as well as those of the South American republics

This is but a rough sketch of the career of Dr Toussaint To all who knew and associated with him he was known as a man who did honor to his country as he would have done honor to any country in which he might have been born, and so it is fitting that, as a just homage to the wise physician and the noble and generous man, his name be included with those who have done much to advance surgery in the Americas

BENJAMIN BANDERA

THE SURGEON'S LIBRARY

OLD MASTERPIECES IN SURGERY

ALFRED BROWN, M.D. F.A.C.S., OMAHA

LANFRANCUS OF MILAN

AS the authority of the school of Salerno waned the position of the sites of supremacy in medicine and surgery tended to spread northward, in Italy, to Bologna and passing still farther north to Montpellier and Paris in France. One of the important elements in helping this northward spread was the banishment of Lanfrancus of Milan. Lanfrancus was born in Milan and spent his early professional years as a practicing physician and surgeon in his birth place. At this time, the last half of the thirteenth century, the most notorious thing in Italy was the constant war between the Guelphs and the Ghibellines. It set family against family and town against town and as is usual in small factional fights the feeling engendered was extremely bitter. The original bone of contention, the pre-eminence of the Pope on the one hand or the Emperor on the other had been more or less forgotten and by the third quarter of the thirteenth century the fights had become local and family ones.

Lanfrancus had ranged himself on the side of the Guelphs and in 1290 they were beaten. The leader of the Ghibelline faction, Matteo Visconti, at once banished Lanfrancus from Italy. He fled across the border to France and at first settled in Lyon. Here he busied himself in writing his *Chirurgia Parva* (Little Surgery). After he had been in Lyon a short time he travelled throughout France always practicing and finally in 1295, five years after his banishment, reached Paris. His reputation must have preceded him for immediately upon his arrival in Paris he began to teach and students flocked to him in great numbers to attend his clinics and watch his operations. He became known immediately and was soon asked by his students, by the masters in surgery and even by Jean de Passavant, the dean of the Paris faculty, to write a larger surgery. It would seem that this book must have been in his mind for some time and probably some of it had been written soon after the Little Surgery was finished for he states that he finished the great surgery in 1296 only the year following his arrival in Paris. His dedication of his work to Philip the Fair, King of France, was rather interesting. Being in France it was of course the thing for him to do, but at the same time it allowed him to show that he was still a supporter of the Guelphs, particularly at a time of bitter feeling because the year 1296 marked the great quarrel

between Philip and Pope Boniface VIII brought about by Philip's taxing ecclesiastical property to meet the increased expenses of the centralization of his government.

In spite of the great admiration which Passavant felt for Lanfrancus' ability he did not dare run counter to the University requirements and afford him facilities for teaching. The rules required that all teachers of medicine in the University must be clerics and celibates. Lanfrancus unfortunately for the University, was married and had a son and had to look elsewhere if he was to teach. The opportunity was afforded by the College de Saint Cosme which had been founded by the Royal Physician Jean Pitard during the reign of Louis IX (St. Louis). This guild of surgeons had attained a position of great importance and its requirements for admission were very strict. A candidate must have studied medicine and philosophy for two years, must understand Latin, and must have studied surgery for two additional years. He was then admitted into the guild and was allowed to wear a long robe in contradistinction to the lower class of less educated surgeons who could wear a short robe only. Pitard apparently waived these requirements for Lanfrancus and the same year that he arrived in Paris, 1295, he became a member of the College and began to carry on his teaching under its auspices.

Lanfrancus' method was entirely different than anything which had been done before. His operations were done in public and to them his students were admitted. His lectures, instead of being the conventional dry reading from a book of one of the ancients, were clinical demonstrations of the patients themselves. Almost immediately his courses became overcrowded and he was the most popular teacher of surgery in France. In this way the surgery of Italy was carried northward into France.

Though Lanfrancus was a pupil and follower of William of Salicet he was by no means as daring in his operative work as either Salicet or his master and predecessor Roger. In fact Lanfrancus seemed to be imbued with the teaching of the Arabists and reverted to the use of the cautery instead of the knife which latter had been advocated by his master William of Salicet. He was a timid operator and preferred to let nature take its course in serious cases rather than intervene. His greatest reputation rests upon the fact that he was the first clinical demonstrator in France.

Klein Wundartzney.

Von aller=
hand Wundē/
Brüchen / Schä-

den vnd Gebrechen/ inn vnd außserhalb
Leibs / wie die gründlichen zu Curieren
vnd heilen seyen Anfanglich durch den Hocher
farnen vnd weitberümpften D. Lanfranc
cum inn Latein beschriben/ Nachmals
aber gemeinem nutzen zu gha
tem inn Teütsch ges
bracht.

Zusamt einem Außzug viler be
werter Recepten/heylsamer Salben/vnd
Arzneyen/D Ottonis Brunfelsij. Zehn
new inn Truck geben.



Zu Franckfort am Meyn/ Bey
Christian Egenolffs Erben.

M. D. L. XIX. 5

REVIEWS OF NEW BOOKS

THE title *Prosthetic Dentistry, An Encyclopedia of Full and Partial Denture Prosthesis*¹ aptly describes the work. It is a well prepared volume of forty-two chapters dealing with all phases of prosthetics and allied subjects, from a thorough description of anatomical structures to a treatise on the surgical preparation of the mouth for dentures and complete description of technical procedures and mechanical appliances. There are 830 illustrations, all of which are exceptionally well prepared and add much to the value of the work. The text is not confined to the author's opinions but presents much of the best which is recent and accepted in this field. The collaborating authors include many outstanding dental authorities and several technicians, but there is a pleasing lack of useless repetition.

The book can scarcely be considered suitable as a standard text for teaching but rather as a reference collection of the latest thought in this field, more accessible than current literature. A considerable amount of material will prove to be of passing rather than permanent value, especially the minute description of technical methods, which are subject to change, and the pet theories and ideas of individual authors.

A chapter of unusual interest is presented by V. H. Kazanjian on "Prosthetic Restoration of Deformities of Face and Jaw," which is fully descriptive of many ingenious prosthetic appliances for correcting serious deformities.

The book may be considered a useful addition to a dentist's library and can well be read with profit.

CHARLES W. FREEMAN

THE important system of microscopic anatomy, produced under the general editorship of Wilhelm von Moellendorff,² is doing for histology, but in even more ambitious fashion, what that epochal co-operative reference work edited by Keibel and Mall did for embryology some 20 years ago. The plan is much the same. Chapters have been assigned to well qualified experts, and although it is probable that an international representation would have worked to advantage, yet the authoritative contributions as furnished can not fail to command respect. In the present volume the high standard of the parts already published has been maintained. W. von Moellendorff contributes a section on the urinary

system and R. Schroeder one on the female reproductive system. Both are masterful presentations of these intricate subjects. The descriptions are well balanced and sufficiently exhaustive. Histologists and all others who may have occasional need to consult original sources will find prepared for them the easiest approach available to the special and detailed information wanted. The illustrations are excellent and adequate, even if less elaborate than those of certain previous volumes. The literature is copiously cited and extensive bibliographies are furnished. Unfortunately, as is customary with European authors, many fundamental American contributions are either not well known or else ignored to the benefit of European equivalents. The price of these volumes, although almost prohibitive to the individual, is presumably necessary in view of the limited distribution open to a detailed reference work of this kind.

L. B. A.

BELL has five collaborators in this volume³ on pathology, which is somewhat smaller than most texts on this subject. Its format is didactically logical, with individual, often numbered, headings followed by short descriptions. The table of contents is quite complete. The illustrations are numerous and fairly well chosen. In general the drawings of tissue preparations are better than the photographs.

The subject matter is not specifically divided into general and special pathology but the chapters are arranged in that fashion, thus following the traditional manner of teaching pathology. Because of the numerous headings, the general style is somewhat jerky.

Presentation of renal pathology may well attract interest because it is based upon a rich personal experience and well formulated thought. Newer concepts of kidney lesions as presented show a laudable attempt to correlate pathological states with their prototypes. The section on the circulatory system likewise benefits from the knowledge of the special worker.

Proper names and references are used very sparingly in the text, and while this avoids controversial points, it may give the student an ambiguous idea of accrediting special work. An example at random might be pointed in the omission of Cushing's name in the discussion of brain tumors.

This book, on the whole, might be the outgrowth of a system of lectures, and if so, will probably fill its niche.

HAMILTON R. FISHBACH

³A TEXT BOOK OF PATHOLOGY Edited by E. T. Bell M.D. Philadelphia: Lea and Febiger 1930.

¹PROSTHETIC DENTISTRY. AN ENCYCLOPEDIA OF FULL AND PARTIAL DENTURE PROSTHESIS. By Ira Goodell Nichols D.D.S. With collaboration of forty five authors. St. Louis: The C. V. Mosby Company 1930.
²HANDBUCH DER MIKROSKOPISCHEN ANATOMIE DES MENSCHEN. Edited by Wilhelm v. Moellendorff. Vol. VII—Harn und Geschlechts apparat. Part 1: Exkretionsapparat und weibliche Genitalorgane. By W. v. Moellendorff and R. Schroeder. Berlin: Julius Springer 1930.

AMERICAN COLLEGE OF SURGEONS

ORGANIZATION OF SERVICE FOR THE DIAGNOSIS AND TREATMENT OF CANCER—A MINIMUM STANDARD

RECOMMENDED BY THE COMMITTEE ON THE TREATMENT OF MALIGNANT DISEASES,¹
AMERICAN COLLEGE OF SURGEONS

WHILE recognizing that there are many unsolved problems with regard to cancer, the Board of Regents of the American College of Surgeons, on the advice of its Committee on the Treatment of Malignant Diseases, has announced its policy of emphasizing the necessity of making the benefits of contemporaneous knowledge of cancer available to each and every cancer patient in the country. The College is convinced that, while awaiting future discovery of more efficient methods of treatment of the disease, it is possible effectively to reduce the suffering and mortality from cancer by an organized application of the knowledge that already is available.

The merits of cancer institutes and cancer laboratories are fully acknowledged, but it is felt that there is an urgent need for making our present knowledge more generally effective, and that this need can be met most efficiently through the formation of cancer clinics in approved general hospitals. Such already existing hospitals form the natural centers in which modern diagnostic and therapeutic procedures should be conducted, and constitute a means for an immediate widespread influence on the disease. Ordinarily these hospitals have the personnel and equipment for such service but a definite organization for this special service is necessary in order to obtain the maximum of efficiency in the campaign against cancer. The utilization of already existing hospitals for this purpose has the additional advantage of entailing the minimum of increased expenditure for the accomplishment of the purpose.

¹The Committee on the Treatment of Malignant Diseases consists of Robert B. Greenough, Boston, chairman; Albert C. Broders, Rochester; Curtis F. Burnam, Baltimore; George W. Crile, Cleveland; Bowman C. Crowell, Chicago; William Duane, Boston; F. W. C. Kerr, St. Louis; John M. T. Finney, Baltimore; Burton J. Lee, New York; Frank Lynch, San Francisco; Robert F. Miller, Jr., Baltimore; Henry K. Lancaster, Philadelphia; H. Gideon Wells, Chicago; and Francis C. Wood, New York. Communications concerning the subject dealt with in this article may be addressed to Bowman C. Crowell, M.D., Director of Clinical Research, American College of Surgeons, 40 East Lake Street, Chicago, Illinois.

²Surg. Gynec. & Obst. 1930 li 570

While the standard herewith presented applies especially to hospitals, other institutions that are shown to have the required personnel organization and equipment for carrying on the work according to these standards may be included in the list of cancer clinics approved by the College.

In the publication to which reference has already been made the general recommendations of the College in regard to such clinics were outlined. There is presented below a more specific statement in the form of a minimum standard for cancer clinics and cancer services in general hospitals in which are formulated the requirements for an acceptable cancer clinic or cancer service. The Committee on the Treatment of Malignant Diseases takes the position that compliance with this standard forms one of the best methods of assuring to the patient the maximum benefits of our present knowledge of cancer. Explanatory comments on each of the clauses of this minimum standard are appended. These comments are followed by a repetition from the previous publication of the relation which the American College of Surgeons will bear to the cancer clinics.

MINIMUM STANDARD FOR CANCER CLINICS

1. **Organization.** There shall be a definite organization of the service, and it shall include an executive officer and representatives of all the departments of the hospital which are concerned in the diagnosis and treatment of cancer. The services of a secretary and of a social service worker shall be available.
2. **Conferences.** As an essential feature of the service there shall be regular conferences or consultations at which the diagnosis and treatment of the individual cases are discussed by all members of the clinic who are concerned with the case.
3. **Patients.** Reference to the cancer clinic of all patients in whom the diagnosis or treatment of cancer is to be considered shall be either a volun-

tary or obligatory in accordance with the vote of the medical staff or of the governing board of the hospital

- 4 *Equipment* In addition to the diagnostic and therapeutic surgical equipment which is required in every approved general hospital there shall be available an apparatus for X-ray therapy of an effectiveness which is generally agreed upon as adequate, and an amount of radium sufficient to insure effective treatment
- 5 *Records* In addition to the records which are required in every approved general hospital, there shall be additional records of (a) The details of the history and of the examination for cancer in different regions of the body, such as are indicated on the form records which are recommended by the Committee on the Treatment of Malignant Diseases, American College of Surgeons (b) The details of the treatment by radium or X-ray as indicated on the form records which are recommended by the Committee on the Treatment of Malignant Diseases, American College of Surgeons (c) Periodic examinations at intervals for a period of at least five years following treatment
- 6 *Treatment* The treatment of cancer patients shall be entrusted to the members of the staff of the cancer clinic except in cases in which adequate treatment in accordance with the collective recommendation of the staff of the cancer clinic can be procured otherwise

DETAILED EXPLANATION OF THE MINIMUM REQUIREMENTS FOR CANCER CLINICS

CLAUSE I

Organization There shall be a definite organization of the service, and it shall include an executive officer and representatives of all the departments of the hospital which are concerned in the diagnosis and treatment of cancer. The services of a secretary and of a social service worker shall be available

The staff of a cancer clinic or cancer service should include primarily representatives selected from the departments of surgery, pathology, and radio-therapeutics who are qualified by a special knowledge of cancer in their respective fields

The American College of Surgeons regards cancer as essentially a surgical disease, and as a rule a surgeon who is a Fellow of the American College of Surgeons should be selected as executive officer of the clinic. However, the accurate diagnosis and the effective treatment of cancer today must be regarded as a group problem which requires the co operative efforts of representatives of these

several departments who have been trained adequately to bring contemporaneous knowledge and experience to the consideration of the individual cancer case

Within the surgical division of the clinic representatives of the surgical specialties, such as gynecology, urology, and surgery of the diseases of the eye, ear, nose, and throat, should be included, and representatives of the departments of internal medicine and dermatology and such other special departments of the hospital as may be concerned in the diagnosis and treatment of cancer cases should also be included

The special services of a secretary are essential for recording accurate data in regard to the diagnosis and treatment, and for the maintenance of card catalogues with cross references of patients and diseases. The social service worker's assistance is of the utmost value in maintaining an effective follow-up system by which end-results of treatment may be determined, and she should work in close co operation with the secretary of the clinic

CLAUSE II

Conferences As an essential feature of the service there shall be regular conferences or consultations at which the diagnosis and treatment of the individual cases are discussed by all members of the clinic who are concerned with the case

The essential feature of a cancer clinic is the group method of study of cancer cases. This is accomplished by a conference of the staff which includes representatives of all of the departments concerned. Such a meeting may be held daily or at longer intervals. It may be formal or informal, but its purpose should be the discussion of the diagnosis of each individual case, the consideration of the details of information obtained from the pathological and radiological laboratories, and a discussion of the methods of treatment which may be expected to give the best results. In addition to the discussion of individual cases by members of the clinic staff, from time to time reports should be presented of the end results of treatment of different forms of cancer, with a comparison of the results obtained in similar cases in other clinics

In the development of these conferences of the members of the clinic, it is of great value to encourage the attendance of members of the medical profession who are not members of the clinic, and to present at intervals patients who have been the subject of previous treatment

CLAUSE III

Patients Reference to the cancer clinic of all patients in whom the diagnosis or treatment of cancer is to be considered shall be either voluntary or obligatory in accordance with the vote of the medical staff or of the governing board of the hospital

As a matter of expediency, at the time of the first organization of a cancer clinic reference of patients to it may be made a purely voluntary matter on the part of the other members of the hospital staff. As the clinic becomes established in many hospitals it is found desirable that all cases of cancer or suspected cancer should be automatically referred to the cancer clinic for preliminary investigation. In any case, it should be obligatory that all cases of cancer on discharge from the hospital be referred to the cancer clinic for subsequent follow up

CLAUSE IV

Equipment In addition to the diagnostic and therapeutic surgical equipment which is required in every approved general hospital there shall be available an apparatus for X ray therapy of an effectiveness which is generally agreed upon as adequate, and an amount of radium sufficient to insure effective treatment

Every approved general hospital at the present day has instruments and apparatus available for diagnosis where operative procedures, such as the examination of the bladder, bronchus, œsophagus, rectum, and sigmoid, are required, together with the instruments and appliances for general surgical work, including electro surgical equipment. An approved hospital has also a complete X ray apparatus for diagnostic purposes. However, for the effective treatment of cancer cases the department of radiotherapy should be supplied with equipment sufficient to insure high voltage X ray therapy and an amount of radium sufficient to insure effective treatment. At the present time it is the opinion of the Committee that the X ray therapy apparatus should have an effective strength of 200,000 volts, and that at least 200 milligrams of radium in the form of salt or an equivalent amount of emanation should be available

The pathological department of the hospital must also be equipped to provide information in regard to tumors in the light of modern knowledge of this subject. Such reports should include not

only the pathological diagnosis of cancer but also further details in regard to classification of the type and degree of malignancy, and, where possible, an estimate of the radio-sensitivity of the tumor

Provision should also be made for the permanent preservation of microscopic slides and gross material, as well, and all of this material should be preserved, filed, and catalogued in such a way that a review of the material may be readily accomplished at some future time when special study of this subject may be required

CLAUSE V

Records In addition to the records which are required in every approved general hospital, there shall be additional records of (a) The details of the history and of the examination for cancer in different regions of the body, such as are indicated on the form records which are recommended by the Committee on the Treatment of Malignant Diseases, American College of Surgeons (b) The details of the treatment by radium or X ray as indicated on the form records which are recommended by the Committee on the Treatment of Malignant Diseases American College of Surgeons (c) Periodic examinations at intervals for a period of at least five years following treatment

The special records used in the cancer clinic consist chiefly of the complete record forms for history, examination, diagnosis, and treatment, which are recommended by the College with a view to making the records of different clinics uniform and comparable. Samples of these record forms may be obtained from the Department of Clinical Research of the College. To insure that all the necessary data are obtained the responsibility for filling out these forms should be placed definitely upon the examining physician. In addition, provision must be made by a card catalogue system to control the follow up of patients after they have been discharged from the hospital, and to insure investigation of cases which fail to report to the clinic before so much time has elapsed as to make their investigation difficult

CLAUSE VI

Treatment The treatment of cancer patients shall be entrusted to the members of the staff of the cancer clinic except in cases in which adequate treatment in accordance with the collective recommendation of the staff of the cancer clinic can be procured otherwise

In cases in which treatment by surgery or by radiation requires special knowledge or technique it is advisable that such treatment be given by members of the staff of the cancer clinic. However, in such cases as require treatment by surgery or by radiation which can be provided by others than members of the clinic staff, the special assignment of these cases to the staff of the cancer clinic is not essential. In general, it is to be recognized that members of the hospital staff who accept service in the cancer clinic thereby deprive themselves of certain professional experience in other lines, and it is not unreasonable to expect the other members of the staff of the hospital to recognize that fact by assenting to a reassignment of the clinical material of the hospital which will give to each member of the staff an equal opportunity for development of his special interests.

RELATION OF THE AMERICAN COLLEGE OF SURGEONS TO THE CANCER CLINIC

The American College of Surgeons through its Committee on the Treatment of Malignant Diseases, Department of Clinical Research, will co-operate with the cancer clinics in the following respects:

It will furnish to men and hospitals desiring to form such clinics information as to the methods to be adopted in the organization of the clinics.

It will put the stamp of approval of the College on such clinics as conform to the standards of the College for such clinics.

It will furnish to the clinics samples of uniform record blanks for the recording of their cases.

It will ask the clinics to co-operate in furnishing data on their cases for a scientific study of the results of treatment by various methods. This study will be a continuation of the studies that the Committee has been making during several years on data furnished by a limited number of selected clinics, the results of which have been published.

It will furnish the clinics with an opportunity of discussing their administrative problems in a series of round table conferences at each of the annual Clinical Congresses of the College and at the sectional meetings of the College which are held throughout the country each year.

It will publish and distribute to the clinics the results of its studies, based on the data collected, after analysis by the committee.

It will issue in the *Bulletin* of the College from time to time articles dealing with the administrative and scientific phases of the clinic work, and the proceedings of such round table conferences and symposiums as may be held.

It will co-operate with the clinics in such ways as may be to their advantage.

CLINICAL CONGRESS OF AMERICAN COLLEGE OF SURGEONS

C. JEFF MILLER, NEW ORLEANS *President*

ALLEN B. KANAVEL, CHICAGO, *President Elect*

FRANKLIN H. MARTIN *Director General*

CHARLES GORDON HEYD, *Chairman, New York Committee*

JOHN L. JENNINGS, *Chairman, Brooklyn Committee*

PRELIMINARY CLINICAL PROGRAM FOR THE NEW YORK-BROOKLYN CLINICAL CONGRESS

A PRELIMINARY program of the clinics and demonstrations to be given in the hospitals and medical schools of New York and Brooklyn during the twenty-first annual Clinical Congress of the American College of Surgeons, October 12-16, is presented in the following pages. The surgeons of greater New York are keenly interested to provide a complete showing of the surgical activities of that great medical center, and the final program will include clinics in all branches of surgery—general surgery, gynecology, obstetrics, orthopedics, urology, proctology, and surgery of the eye, ear, nose, throat, and mouth. Clinics are scheduled for Monday afternoon, beginning at 2 o'clock, and for the mornings and afternoons of each of the four following days.

The program as published at this time is merely an outline or basis for the final program. During the months preceding the Congress the hospital schedules will be revised and amplified so that in its final form the program will present a completely detailed schedule of the clinical work to be demonstrated. At three previous sessions in that city most attractive clinical programs have been presented, and we have the confident assurance of the Committee on Arrangements that in scientific interest this year's Congress will surpass all previous efforts.

Fracture clinics, at which modern methods in the treatment of fractures will be demonstrated, will be a feature of the clinical program. At many of the hospitals plans are being made for a comprehensive showing of methods employed and results obtained in the treatment of fractures, which forms so large a part of the surgical work in large cities and industrial centers. Other important features of the clinical program include demonstra-

tions in the treatment of cancer by surgery, radium, and X-ray, electrosurgery, rehabilitation by surgery and physical therapy of patients injured in industrial accidents, etc.

Wednesday, October 14 will be "Brooklyn Long Island Day." For that day the Committee on Arrangements is preparing a special program of clinics and demonstrations in the hospitals of that borough with other scientific features for the entertainment of the visiting surgeons.

MEETING MEETINGS

The Executive Committee of the Congress is preparing programs for a series of five evening meetings at which distinguished surgeons of the United States and Canada and eminent surgeons from abroad will present papers dealing with varied surgical subjects of present-day interest. At the presidential meeting on Monday evening in the grand ballroom, the president elect, Dr. Allen B. Kanavel of Chicago, will be inaugurated and deliver the annual address. Mr. Arthur H. Burgess, M.B., F.R.C.S., Manchester, England, professor of clinical surgery in Victoria University, Manchester, and president of the British Medical Association will present the John B. Murphy oration in surgery on that occasion. At one of the evening meetings Professor William Darrach, of Columbia University, will deliver the annual fracture oration. At the annual convocation of the College on Friday evening, the 1931 class of candidates for fellowship in the College will be received.

Programs are being prepared for special meetings on Tuesday and Wednesday evenings at the New York Academy of Medicine in conjunction with the sections on ophthalmology and otolaryn-

gology of the Academy, at which a number of outstanding American ophthalmologists and otolaryngologists will present papers of interest to those who practice these specialties. Complete programs for these two sessions will be published at an early date.

FEATURES OF THE PROGRAM

Among the important features of this year's Congress will be a cancer symposium, and one session devoted to a consideration of the essentials in the organization and administration of cancer clinics throughout the country under the guidance of the College.

A conference on traumatic surgery under the auspices of the Board on Industrial Medicine and Traumatic Surgery is being arranged for one day, the program for which will include presentations by leaders in industry as well as surgeons and hospital administrators.

The newest surgical films, both sound and silent, will be shown daily at headquarters. In addition to films that have been produced under the supervision of the Board on Medical Motion Picture Films of the American College of Surgeons, an extensive program of film contributions will be presented.

HOSPITAL CONFERENCE

An interesting program of papers, round table conferences, and practical demonstrations dealing with the problems related to the hospital standardization program of the College and hospital efficiency in general is being prepared for the annual hospital conference which opens at 10 o'clock on Monday morning in the grand ballroom of the Waldorf-Astoria Hotel. The conference continues Monday afternoon and on Tuesday and Wednesday both morning and afternoon. The program for this conference is planned to interest surgeons, hospital trustees, executives, and nurses, and an invitation to attend is extended to all persons interested in the hospital field.

HEADQUARTERS

General headquarters for the Clinical Congress will be established at the new Waldorf-Astoria Hotel, located on Park Avenue between 49th and 50th Streets. This magnificent new hotel, with more than 2,000 guest rooms, which is now nearing completion and will open early in the fall, affords unusual facilities for sessions of the Clinical Congress. The grand ballroom and other large rooms and foyers on the second floor of the hotel have been reserved for the exclusive use of the

Congress, to be used for scientific meetings, conferences, film exhibitions, registration and ticket bureaus, bulletin boards, executive offices, scientific and technical exhibitions, etc. All the comforts and facilities of the old Waldorf-Astoria, which had been headquarters on the occasion of three previous Congresses, will be found in the new hotel with many added attractions and conveniences.

Space has been reserved in the Astor Gallery, Jade Room, and other large rooms and foyers on the second floor of the hotel adjacent to the grand ballroom for the Technical Exhibition, in which will be represented the leading manufacturers of surgical instruments, X-ray apparatus, operating lights, hospital apparatus of all kinds, pharmaceuticals, publishers of medical books, etc.

LIMITED ATTENDANCE—ADVANCE REGISTRATION

Attendance at the New York-Brooklyn session will be limited to a number that can be comfortably accommodated at the clinics, the limit of attendance being based upon the result of a survey of the amphitheaters, operating rooms, and laboratories in the hospitals and medical schools to determine their capacity for accommodating visitors. Under this plan it will be necessary for those who wish to attend to register in advance.

Attendance at all clinics and demonstrations will be controlled by means of special clinic tickets, which plan provides an efficient means for the distribution of the visiting surgeons among the several clinics and insures against overcrowding, as the number of tickets issued for any clinic will be limited to the capacity of the room in which that clinic will be given.

A registration fee of \$5.00 is required of each surgeon attending the annual Clinical Congress, such fees providing the funds with which to meet the expenses of the meeting. To each surgeon registering in advance a formal receipt for the registration fee is issued, which receipt is to be exchanged for a general admission card upon his registration at headquarters. This card, which is non-transferable, must be presented in order to secure clinic tickets and admission to the evening meetings.

An application for reduced railway fares on account of the meeting in New York and Brooklyn is pending before the railroad traffic associations, and it seems assured that a round trip rate of one and one-half the regular first class one-way fare will be in effect from all points in the United States and Canada.

PRELIMINARY CLINICAL PROGRAM

GENERAL SURGERY, GYNECOLOGY, OBSTETRICS, ORTHOPEDICS, UROLOGY,
PROCTOLOGY, SURGICAL PATHOLOGY, ETC.

CLINICS IN NEW YORK HOSPITALS

BELLEVUE HOSPITAL

Monday

WILLIAM T. DORAN and associates—2 Gall bladder disease
A. R. STEVENS and staff—2 Demonstration of urological cases

Tuesday

RUSSEL H. PATTERSON—9 General surgery
ARTHUR M. WRIGHT and staff—9 General surgery
ARTHUR S. McQUILLAN and IIGENE BRICK—9 Diseases of the thyroid
F. C. HOLDEN and staff—9 Gynecological clinic
IRA KAPLAN and staff—9 Treatment of malignancies by radiation
A. R. STEVENS and staff—1 Urological operations

Wednesday

JOHN I. SUTTON—9 General surgery
ARTHUR M. WRIGHT and staff—9 General surgery
F. C. HOLDEN and staff—9 Gynecological clinic
IRA KAPLAN and staff—9 Treatment of malignancies by radiation
HENRY M. LEWIS, J. J. SIBBS and F. ESTER BREIDENBACH—2 Fracture clinic
A. R. STEVENS and staff—2 Urological clinic

Thursday

Staff, second surgical division—9 General surgery, dry clinic
JOHN H. MORRIS and JOHN A. ROHRER—9 Chest surgery
GEORGE D. STEWART, ARTHUR M. WRIGHT and staff—11 30 General surgery dry clinic

Friday

CARL C. BURDICK—9 General surgery
GEORGE D. STEWART, ARTHUR M. WRIGHT and staff—11 General surgery
JAMES W. HINTON—2 Gastrointestinal clinic
A. R. STEVENS and staff—2 Urological operations

MEDICAL CENTER

(Babies Neurological Presbyterian and Sloane Hospitals)

Monday

J. BENTLEY SQUIER—2 Urological operations

Tuesday

BENJAMIN F. WATSON—9 Gynecological clinic

Wednesday

HUGH ALCHINGLOSS—9 Surgery of the breast

Thursday

JORDACE H. ST. JOHN—9 Surgery of the stomach and duodenum

Friday

WILLIAM DARRACH—9 Fracture clinic

NEW YORK POST GRADUATE HOSPITAL

Monday

IRVING H. ALBERT—2 Orthopedic surgery
JOHN D. STEWART—3 Rectal surgery
H. W. MOFFATT—4 30 Orthopedic surgery

Tuesday

J. F. MCCARTHY—9 Urology
J. I. FREDMAN—9 General surgery
J. EASTMAN SHEEHAN—9 Plastic surgery
H. S. VACCARI—11 Oral surgery
W. T. DANNFUTHER—2 Gynecology
CHARLES OGILVY—4 30 Orthopedic surgery

Wednesday

THOMAS CHERRY—9 Gynecology
CHARLES GORDON HEND—2 General surgery
W. T. DANNFUTHER—2 Gynecology
BYRON STOKLEY—2 Neurological surgery

Thursday

IRVING H. ALBERT—9 Orthopedic surgery
J. F. MCCARTHY—9 Urology
J. I. FREDMAN—2 Traumatic surgery
GEORGE MONROE—4 30 Orthopedic surgery

Friday

THOMAS CHERRY—9 Gynecology
J. EASTMAN SHEEHAN—9 Plastic surgery
J. I. FREDMAN—2 30 General surgery
W. T. DANNFUTHER—2 Gynecology
CHARLES OGILVY—4 30 Orthopedic surgery

MOUNT SINAI HOSPITAL

Monday

ROBERT T. FRANK and staff—2 Plastic operations on the vagina
RICHARD LEWISON—2 Blood studies in jaundice cases

Tuesday

EDWIN BYER and staff—2 Genito-urinary surgery
HAROLD NEUFOP—2 Demonstration of thoracic cases
W. HARRIS—2 Radiotherapy of surgical diseases

Wednesday

EDWARD W. NATHAN and staff—9 Orthopedic surgery
A. A. BERG and staff—2 Gastrointestinal surgery
GEORGE BAFER and I. ALLIENBERGER—3 30 Pathological demonstration

Thursday

RICHARD LEWISON and staff—2 Thyroid surgery
ROBERT T. FRANK—2 Reconstruction of vagina demonstration of female sex hormones blood and urine tests
LEOPOLD JACRES and staff—2 Roentgenological aspects of surgical diseases

Friday

EDWARD W. NATHAN—9 Demonstration of orthopedic cases
HAROLD NEUFOP and staff—2 Chest surgery

WOMAN'S HOSPITAL

Tuesday

HERMAN GRAD and E A BULLARD—9 Gynecological operations

H G BUGBEE and staff—9 Urological clinic
GEORGE GRAY WARD, L K P FARRAR and W T KENNEDY—2 Gynecological operations

GRETE STOHR—2 Pathological demonstration
W H GLAFKE—2 30 Gastro enterological clinic, relating to gynecology

Wednesday

H E PARDFE—9 Cases of pregnancy complicated with heart disease

E C LYON and assistants—10 Demonstration of obstetrical ward and delivery room technique

GEORGE GRAY WARD and L K P FARRAR—11 Exhibit of radium cases

GRETE STOHR—2 Pathological demonstration

Thursday

R M RAWLS and A H ALDRIDGE—9 Gynecological operations

H G BUGBEE and assistants—9 Urological clinic

B H GOFF and R HURD—2 Gynecological operations

GRETE STOHR—2 Pathological demonstration

HARRIET MCINTOSH—2 30 X-ray diagnosis and therapy in gynecology and obstetrics

E C LYON and assistants—3 New follow up system in obstetrics

Friday

HERMAN GRAD and F A BULLARD—9 Gynecological operations

GEORGE GRAY WARD, L K P FARRAR and W T KENNEDY—2 Gynecological operations

GRETE STOHR—2 Pathological demonstration

E C LYON and assistants—3 Demonstration of obstetrical ward and delivery room technique

NOTE—Daily demonstrations "Standardized Technique," by the Nursing Staff, "Keeping of Records" by Record Librarian. Inspection of new out patient clinic on Wednesday and Friday

HOSPITAL FOR RUPTURED AND CRIPPLED

Tuesday

CARL G BURDICK and staff—9 Hernia operations
ARMITAGE WHITMAN and staff—2 Dry clinic Adduction treatment of fractures of the neck of femur

Wednesday

FENWICK BEEKMAN and staff—9 Hernia operations
WILLIAM B COLEY and BRADLEY L COLEY—2 Dry clinic Bone sarcomas

Thursday

PERCY W ROBERTS, WILLIAM L SNEED and staff—9 Orthopedic clinic

JOHN E McWHORTER—2 Pathological demonstration of bone tumors

Friday

WILLIAM L SNEED and staff—9 Orthopedic operations

LYING IN HOSPITAL

JAMES A HARRAR C F JELLINGHAUS, L A WING M ROSENSOHN, W H HAWKINS, K B STEELE, J R SMITH, J A O'LEGAN, N B SACKETT, J T SHERMAN, W C GODDARD and R I CRAIG—9, daily Obstetrical clinics and laboratory demonstrations

ROOSEVELT HOSPITAL

Tuesday

ALFRED STILLMAN—9 General surgery

HOWARD C TAYLOR—9 Gynecology

CONDUCT CUTLER—10 General surgery

Wednesday

KIRBY DWIGHT—9 General surgery

THOMAS PEIGHTAL—9 Gynecology

GRANT P PENNOYER—10 General surgery

Thursday

WILLIAM C WHITE—9 General surgery

HOWARD C TAYLOR, JR—9 Gynecology

HOWARD A PATTERSON—10 General surgery

Friday

EDWARD F KILBANE—9 Urology

FLOWER HOSPITAL

Monday

CLAUDE BURRETT—2 Gout problems

EARL EATON—2 Hernia clinic

Tuesday

HORACE AYERS—9 Tumors of the pelvis

HENRY SAFFORD—9 Elective caesarean

SPRAGUE CARLETON—2 Prostatic problems

WALTER HALPMAN—2 Kidney tumors

RAPHAEL LEWY—2 Industrial surgery

Wednesday

LOUIS KAUFMAN—9 Hydronephritis

SAHUEL LUBASH—9 Kidney function tests

ANSON H BINGHAM—2 Orthopedic surgery

MILTON WILSON—2 Compound fractures

Thursday

WILLIAM F HONAN—2 Thoracic surgery

Friday

JOSEPH H FOBES—9 General surgery

WILLIAM A FRASER—9 General surgery

WILLIAM P ECKES—9 General surgery

GEORGE W LUTTON—2 Traumatic infections of the hand

E WELLES KELLOGG—2 Obscure infections of wounds

NOTE—Demonstrations in newer methods of anesthesia by Donald Brace, James Gales, and George Van Gilluwe

HARLEM HOSPITAL

Monday

Staff—2 Conference on pathology and surgery

Tuesday

H C FALK and staff—9 Gynecology

SIDNEY ADLER—2 Rectal diseases

Wednesday

JOHN F CONNORS, J WISNER, L WRIGHT and J STEV

BUCK—9 Traumatic surgery

Thursday

H B EISBERG and C CASASSA—9 General surgical clinic.

A M SALA and B N BERG—2 Surgical pathology

Friday

H C FALK—9 Diagnostic gynecology

F KASSEBOHM—2 Obstetrical clinic

NEW YORK POLYCLINIC HOSPITAL

Monday

FRANK C. YEOMANS—1 30 Operative proctology
D. A. SINCLAIR—3 Urological operations
I. C. KELLER—4 30 Dry clinic Surgical anatomy

Tuesday

MALCOLM CAMPBELL—9 Operative gynecology
HAROLD D. MEEKER—11 General surgical operations
JEROME M. LAYCH—1 30 Operative proctology
ROSS McPHERSON—3 Obstetrical clinic
JOHN J. NUTT—4 30 Orthopedic operations

Wednesday

GEORGE B. LEE—9 Gynecological operations
A. I. SELLENINGS—11 General surgical operations
EDWARD L. KELLING—1 30 Gastroenterology
J. J. VALENTINE—3 Urological operations
CHARLTON WALLACE and THURICK NICHOL—4 30 Orthopedics

Thursday

D. W. TOVEY—9 Operative gynecology
JOHN J. McGRATH—11 General surgical operations
HERBERT C. CHASE—1 30 General surgical operations
EVERETT M. HAWES—3 Obstetrics
J. I. HAMMETT—4 30 Dry clinic Surgery of tongue

Friday

ROBERT I. MCCREADY—9 Operative gynecology
ROBERT I. BRENNAN—11 General surgical operations
W. A. BEALEY—1 30 Fracture clinic
HERBERT B. KEECE—3 Operative urology

CITY HOSPITAL

Monday

E. F. KILDALE—2 Genito-urinary surgery

Tuesday

L. W. CROSSMAN—2 General surgery
G. E. BINKLEY—2 Rectal surgery

Wednesday

I. M. COLIE—2 Gynecology
J. B. CLARK—2 Genito-urinary surgery
J. E. FELD—2 Orthopedic surgery

Thursday

L. W. CROSSMAN—2 General surgery

Friday

E. W. PINHAM—2 Gynecology
J. R. LISA—2 Pathological conference

LEBANON HOSPITAL

Tuesday

HARRY ARANOW, A. J. RONEY and EDWARD SCHNAPPE—9 Gynecology

Wednesday

MILTON R. BOORMAN, PHILIP M. GRAUSMAN, L. MILLER KAHN and HENRY ROTH—9 General surgery

Thursday

HARRY ARANOW, A. J. RONEY and EDWARD SCHNAPPE—9 Gynecology

Friday

MILTON R. BOORMAN, PHILIP M. GRAUSMAN, L. MILLER KAHN and HENRY ROTH—9 General surgery

ST VINCENT'S HOSPITAL

Tuesday

EDWARD L. KEYES and staff—9 Urological clinic
GEORGE R. SELART—9 General surgery
IRVING N. DEALY—9 General surgery
WILLIAM G. DORAN—9 Fractures

Wednesday

RAYMOND I. SULLIVAN—9 Surgical clinic
WILLIAM M. FORD, W. KRUGLER, J. McGRATH, J. HENNESSY and A. KACI—9 Gynecological clinic
WILLIAM G. DORA—2 Orthopedic clinic congenital dislocation of hip

Thursday

GEORGE DAVID STEWART—9 General surgical operations
ARTHUR M. WRIGHT—9 General surgical operations
EDWARD A. KING—9 General surgical operations
LOUIS I. SANMAN—2 Transfusion

Friday

WILLIAM M. FORD, W. KRUGLER, J. McGRATH, J. HENNESSY and A. KACI—9 Gynecological clinic
CONSTANTINE J. MACGUIRE—9 Surgical demonstration of cases

HOSPITAL FOR JOINT DISEASES

Tuesday

P. M. GRAUSMAN—9 General surgery
HARRY GOLDMAN—10 Proctological surgery
H. L. JAFFE—11 30 Pathology

Wednesday

H. L. FRAUMHART, LEO MAYER and M. M. POMERANZ—9 Orthopedic clinic operations and demonstration of cases roentgenological demonstration of bone lesions

Thursday

PALL W. ASCHNER—9 Urological surgery
ARTHUR STERN—10 Gynecological surgery
M. M. POMERANZ—11 Pyelography

Friday

H. FINKELSTEIN—9 Orthopedic operations
SAMUEL KLEFENBERG—10 30 Demonstration of orthopedic patients

MIDTOWN HOSPITAL

Wednesday

J. SIDNEY RITTER—9 30 Urological clinic

Thursday

LOUIS MARTON—9 General surgery

Friday

MARTIN J. SYNNOTT—4 Proctological surgery

KNICK KNOCK HOSPITAL

Monday

PHILIP D. ALLEN—2 Blood transfusion Tindermann method

Tuesday

W. A. IRASER—9 Gynecological clinic
H. J. SHELLEY—2 General surgery

Wednesday

PAUL C. MORTON—9 General surgery

BROAD STREET HOSPITAL

Monday

CHARLES GOODMAN—2 Vascular surgery
GUSTAV TIECK—4 Sinus operations

Tuesday

BENJAMIN TILTON—10 General surgery
WILLIAM KELLOGG—2 Gastro intestinal surgery

Wednesday

A J WALSCHIED—10 Gynecology
MAURICE MELTZER—2 Genito urinary surgery

Thursday

FRED DUNN—10 Oral surgery
FRED H ALBEE—2 Orthopedic surgery

Friday

POL CORVILLOS—10 Thoracic surgery
MAX BARUCH—2 General surgery
T A SULLIVAN—4 General surgery

METROPOLITAN HOSPITAL

Monday

J H FOBES and staff—2 General surgery

Tuesday

SIRAGUE CARLETON and staff—10 Genito urinary surgery
W F HONAN and staff—2 Thoracic surgery

Wednesday

H B SAFFORD and staff—10 Gynecology
R F WARD and staff—2 General surgery

Thursday

W A FRASER and staff—2 General surgery

Friday

A H BINGHAM and staff—10 Orthopedic surgery
L C SALISBURY and staff—2 General surgery

GOUVERNEUR HOSPITAL

Monday

THOMAS H RUSSELL—2 General surgery

Tuesday

WILLIAM V HEALEY—9 Fracture clinic
EDWARD L KELLOGG—2 General surgery

Wednesday

WILLIAM A KELLOGG—9 General surgery
WILLIAM H W KNIPE—10 Obstetrics
PHILIP M GRAUSMAN—2 General surgery

Thursday

JOSEPH GIRDANSKY—9 General surgery
ALBERT E SELLENINGS—2 General surgery

ST MARY'S HOSPITAL

Tuesday

C E FARR—9 Undescended testis in children

Thursday

EDWARD D TRUESDELL—9 Hare lip and cleft palate

Friday

LUCIUS A WING—9 Congenital deformities

NEW YORK ORTHOPEDIC HOSPITAL

Monday

ALAN D SMITH and staff—2 Out patient clinic

Tuesday

Staff—9 Follow up clinic
HALFORD HALLOCK, BENJAMIN P FARRELL and staff—2 Out patient clinic

Wednesday

RUSSELL A HIBBS, BENJAMIN P FARRELL, ALAN D SMITH and HALFORD HALLOCK—9 Operative clinic
ALAN D SMITH and staff—2 Out patient clinic

Thursday

RUSSELL A HIBBS and staff—9 End results in fusion operation for tuberculosis of spine, hip knee and ankle
BENJAMIN P FARRELL, HALFORD HALLOCK and staff—2 Out patient clinic

Friday

RUSSELL A HIBBS, BENJAMIN P FARRELL, ALAN D SMITH, HALFORD HALLOCK and JOSEPH C RISSE—9 Op crative clinic
ALAN D SMITH—2 Out patient clinic

RECONSTRUCTION HOSPITAL

Monday

E A DOOLEY—2 Fractures of the forearm

Tuesday

J J MOORHEAD—9 Traumatic surgery
W D LUDLUM, JR—2 Traumatic surgery

Wednesday

HERBERT BERGAMINI—9 Fracture return follow up clinic
C A PETERSON—10 30 Head and spine injuries

Thursday

W W LASHER—9 30 Injuries of the knee
DAVID GOLDBLATT—10 30 Fractures of the femur
R S ACKERLY—10 30 Clinic

Friday

K G HANSSON—9 Physical therapy
H M HERRING—9 Physical therapy

MONTEFIORE HOSPITAL

Monday

JULIUS GOTTESMAN, MAURICE LENZ and J M ZIEGLER—2 Cancer clinic

Tuesday

P W NATHAN—9 30 Orthopedic surgery

Wednesday

HAROLD NEUCHOF—2 30 Thoracic surgery

Thursday

IRA COHEN—2 Neurosurgical operations

FRENCH HOSPITAL

Tuesday

P R TURNURE, L M ALOFSIN, M I BLANK, H C FALK and staff—9 General surgery

Wednesday

L G COLE and P R TURNURE—9 Surgical and X ray clinic

MEMORIAL HOSPITAL

Monday

- I CRAVER—2 Dry clinic Lymphosarcoma Hodgkin's disease the leucemias

Tuesday

- W HEAL—9 Gynecological dry clinic Demonstration of methods used and cases being treated end results
G BRADLEY—2 Rectal operations radium treatment demonstration of cases and end results

Wednesday

- W B COLEY—9 Bone sarcoma operations demonstration of cases and end results
R HERNDLEN—2 Dry clinic Roentgenological demonstration of bone tumors with end results in X ray treatment of giant cell tumors

Thursday

- Staff—10 General conference
B BARRINGER—2 Urological operations plus radium treatment demonstration of cases with end results

Friday

- R J IEF—9 Operations on mammary carcinoma demonstration of cases with end results
F ADAIR—2 Operations on melanoma and neurogenic sarcomas demonstration of cases with end results

LOKHAM HOSPITAL

Monday

- A G FORMAN—2 General surgical operations

Tuesday

- L MARTON—2 General surgical operations

Wednesday

- F R CUNIFFE—2 General surgical operations

Thursday

- S W ROOSTEIN—9 Orthopedic operations
ALEXANDER NICOLL—2 General surgical operations

Friday

- J H TULFAIR—9 Obstetrical operations
R EMMET WALSH— General surgical operations

BLACKMAN STREET HOSPITAL

Tuesday

- ROBERT KENNEDY and H HEVL—9 Fracture clinic

Wednesday

- RALPH COLP—9 Operative hernia clinic

Thursday

- W WATERS and W SWIFT—9 Orthopedic operations

JERSEY CITY HOSPITAL

(Jersey City N J)

Tuesday

- W G DORAN—2 Fracture clinic

Wednesday

- S B SPRACUE—2 Fracture clinic
C B KELLEY—2 Gynecological clinic

FIFTH AVENUE HOSPITAL

Monday

- BENJAMIN S BARRINGER and staff—2 Urological operations and demonstration of cases

Tuesday

- KINGSLEY ROBERTS—9 Abdominal operations bacteriological studies of normal and infected peritoneal cavity, prenatal clinic
LEON S LOUFAUX and staff—2 Demonstration of delivery room technique

Wednesday

- DOUGLAS GORDON—9 Fracture clinic treatment of fractures in a general hospital
R B PALMER and M W CARR—2 Dental prophylaxis treatment of fractured jaws

Thursday

- I W BANCROFT—9 General surgical operations gynecological dry clinic sterility
WILLIAM I SWEEP—2 Orthopedic operations and demonstration of cases
LEON S LOUFAUX and staff—2 Demonstration of delivery room technique

Friday

- M STANLEY BROWN—9 General surgical operations dry clinic postoperative thrombosis and embolism

NEW YORK HOSPITAL

Tuesday

- JAMES MORLEY HITTET and staff—9 General surgery
O S LOWSLEY—2 Urology

Wednesday

- EUGENE H POOL and staff—9 General surgery
O S LOWSLEY—2 Clinical demonstration

Thursday

- JAMES MORLEY HITTET and staff—9 General surgery

Friday

- EUGENE H POOL and staff—9 General surgery

LINCOLN HOSPITAL

Tuesday

- KIRBY DWIGHT and B SHERMAN—9 General surgical operations
I T HILL—9 Gynecological operations

Wednesday

- I D TRUESPELL and C S ROGERS—9 General surgical operations
P H WILLIAMS—9 Gynecological operations
L GOTTLEB—2 Roentgenology

Thursday

- G AUFRICHT and J IRFEDMAN—9 Plastic surgery

Friday

- I J DAVIS—9 Gynecological operations
KIRBY DWIGHT and staff—10 General surgery

STUYVESANT SQUARE HOSPITAL

- H H M IYEL A S MORROW and K H KENNEDY—9 daily General surgery

BETH ISRAEL HOSPITAL

Monday

HARRY E. ISAACS—2 General surgical operations
HERMAN SCHWARTZ—2 Surgery in children

Tuesday

J. J. HERTZ—10 Gastric surgery
F. G. LANGROCK—11 Surgery in obstetrics
I. C. RUBIN—2 Gynecological operations
MARCUS ROTHSCHILD—2 Medical aspects of surgical cases

Wednesday

I. C. RUBIN—10 Gynecological clinic
A. HYMAN—11 Genito-urinary clinic
A. HYMAN—2 Genito-urinary surgery
LEO DAVIDOFF—2 Neurosurgical operations
I. D. FRIEDMAN—2 Neurosurgical clinic

Thursday

M. ROBINSON—10 Gynecological clinic
LEO DAVIDOFF—11 Neurosurgical clinic
DEWITT STETTIN—2 General surgical operations
A. A. EPSTEIN—2 Medical aspects of surgical cases

Friday

DEWITT STETTIN—10 Surgical clinic
MEYER ROBINSON—2 Gynecological operations
ALFRED PLAUT—2 Pathological conference

LENOX HILL HOSPITAL

Tuesday

FRANK R. OASTLER and staff—9 Gynecological clinic
FRANK R. OASTLER and staff—2 Gynecological clinic

Wednesday

DEWITT STETTIN and staff—9 General surgical clinic
CARL EGGERS and staff—2 General surgical clinic

Thursday

HERMAN FISCHER and staff—9 General surgical clinic
OTTO H. PRICHARDT and staff—2 General surgical clinic

Friday

PERCY H. WILLIAMS and staff—9 Gynecological clinic
PERCY H. WILLIAMS and staff—2 Gynecological clinic

DETENTION HOSPITAL

Tuesday

EDWARD C. BRENNER or HARRY V. SPAULDING—9 Gynecological operations

Thursday

EDWARD C. BRENNER or JOSEPH FULD—9 Gynecological operations

ST LUKE'S HOSPITAL

Tuesday

WALTON MARTIN—9 General surgery
JOHN DOUGLAS—9 General surgery

Wednesday

H. H. M. LYLE—9 General surgery
FRANK S. MATHEWS—9 General surgery

Thursday

EDWARD J. DONOVAN—9 General surgery
WILLIAM T. MACFEE and EDWARD D. TRUESDELL—9 General surgery

Friday

MORRIS K. SMITH—9 General surgery
HENRY G. BUGBEE—9 Genito-urinary surgery
MATHER CLEVELAND—2 Orthopedic surgery

MISERICORDIA HOSPITAL

Monday

F. W. SOVAK—2 Gynecology

Tuesday

ANTHONY H. HARRIGAN—9 General surgery

Wednesday

ROBERT E. BRENNAN—9 General surgery
JACOB HECKMANN—2 General surgery

Thursday

EDWARD F. KILBANE—9 Genito-urinary surgery
ALEXANDER H. SCHMITT—2 Obstetrics

Friday

FRANCIS L. BUTLER—9 Orthopedics
GASTON A. CARLUCCI—2 General surgery

CORRECTION HOSPITAL

Tuesday

EDWARD C. BRENNER—2 General surgery

Wednesday

GEZA GREENBERG—9 Genito-urinary surgery

Thursday

EDWARD C. BRENNER or M. O. MAGID—2 Gynecological operations

ST FRANCIS HOSPITAL

F. G. EDGERTON, T. H. RUSSELL, C. J. VEJVODA and E. A. CAMPBELL—9 daily General surgery and gynecology

CLINICS IN BROOKLYN AND LONG ISLAND HOSPITALS

BROOKLYN HOSPITAL

Tuesday

W. A. SHIRWOOD—9 General surgical operations
V. L. ZIMMERMAN and staff—9 Obstetrical and gynecological clinic and conference

Wednesday

W. A. SHIRWOOD—9 General surgical operations
V. L. ZIMMERMAN—9 Gynecological operations
D. I. McKENNA—12 30 Orthopedic clinic
JOHN F. JENNINGS—2 General surgery

Thursday

W. A. SHIRWOOD—9 General surgical operations
JOHN F. JENNINGS—9 General surgical operations
N. I. RATHBUN—9 Cystoscopic clinic
D. I. McKENNA—10 30 Orthopedic operations

Friday

W. A. SHIRWOOD—9 General surgical operations
N. I. RATHBUN—9 Urological operations
V. L. ZIMMERMAN—9 Gynecological operations
JAMES DEWITT—11 Clinical surgical pathological conference

CLIMBKLAND HOSPITAL

Tuesday

JOHN GAINES and staff—10 Cancer clinic operations and demonstration of cases

Wednesday

JOHN F. JENNINGS, M. M. LUKATE and J. J. CUNY—9 General surgical clinic

Thursday

MERRILL N. LUKATE and staff—9 Gout clinic operations and demonstration of cases
ROBERT I. KINLOCK and staff—2 Urological clinic operations and demonstration of cases

Friday

JOHN F. JENNINGS—9 General surgery dry clinic
MERRILL N. LUKATE and I. T. SHATARI—2 Varicose vein clinic

CONY HOSPITAL

Tuesday

J. EARL MILES—9 30 Gynecology
JOHN H. CRAWFORD—2 Pre and postoperative care of the cardiac patient
RAY M. BOWLES—2 Preparation of the prostate case
J. EARL MILES—2 Miles modification of the Rubin test
ARTHUR C. GRAVES—2 Treatment of postpartum hemorrhage

Wednesday

GEORGE WEBB—9 General surgery
RAY M. BOWLES—2 Urological surgery
A. J. MENDELSON—2 X-ray diagnosis of peptic ulcer
P. L. WISENBERG—2 Discussion of difficult labor

Thursday

GEORGE WEBB and J. EARL MILES—9 General surgery
P. I. NASH—2 Pre and postoperative treatment of diabetic patients
GEORGE WEBB—2 Traumatic surgery
GEORGE G. FISHER—2 Biliary surgery common duct stones

WICKOFF HOSPITAL

Tuesday

JOHN I. BAUER—9 General surgery
JOHN G. KRAUSE—9 General surgery
RUSSELL S. FOWLER—10 General surgery
ARTHUR HOLZMAN—10 General surgery
WILLIAM B. KOSCIANSKI—10 General surgery
RUDOLPH HERRMAN—2 Obstetrics
CARL O. FISCHER—3 Obstetrics
ROSARIO VELLE—4 Urological operations

Wednesday

ALBERT C. COOK—9 General surgery
WILLIAM I. BOZENHARDT—9 General surgery
WILLIAM COOK—9 General surgery
JOHN HOBBS—11 General surgery
CHARLES F. FILLG—11 General surgery
I. O. DREYLER—2 Urological operations
GEORGE JORDES—2 X-ray clinic
HENRY DURLAN—3 Obstetrics

Thursday

JOHN I. BAUER—9 General surgery
JOHN G. KRAUSE—9 General surgery
RUSSELL S. FOWLER—10 General surgery
ARTHUR HOLZMAN—10 General surgery
WILLIAM B. KOSCIANSKI—10 General surgery
RUDOLPH HERRMAN—2 Obstetrics
CARL O. FISCHER—3 Obstetrics
ROSARIO VELLE—4 Urological operations

Friday

ALBERT C. COOK—9 General surgery
WILLIAM I. BOZENHARDT—9 General surgery
WILLIAM COOK—9 General surgery
JOHN HOBBS—11 General surgery
CHARLES F. FILLG—11 General surgery
I. O. DREYLER—2 Urological operations
GEORGE JORDES—2 X-ray clinic
HENRY DURLAN—3 Obstetrics

NORWICH LUTHERAN DIACONISSES HOSPITAL

Tuesday

I. FERRIS—9 General surgery
G. HENTER—9 Orthopedics
C. LANCE—11 Genito-urinary surgery
D. LIVINGSTONE—11 General surgery
I. FERRIS, J. H. B. DOWD and C. L. LANGE—2 Dry clinic

Wednesday

I. SHELTON and L. STORK—9 General surgery
B. HARRIS and H. MFIELD—10 Obstetrics
I. SHELTON, L. STORK, D. LIVINGSTONE and C. M. FISHER—2 Dry clinic

Thursday

W. B. DUKESHIRE and P. PLATON—9 General surgery
ROBERT W. TATE—10 General surgery
J. H. B. DOWD—11 Obstetrics
W. B. DUKESHIRE, P. PLATON and B. HARRIS—2 Dry clinic

Friday

H. A. FISHER—9 Genito-urinary surgery
K. I. SAN LUDRO—9 General surgery
WILLIAM G. LUCKINGER—10 General surgery
WILLIAM G. LUCKINGER, K. P. SAN LUDRO, ROBERT W. TATE and H. A. FISHER—2 Dry clinic

KINGS COUNTY HOSPITAL

Tuesday

- E H FISKE, J TENOPYR and J RAPHAEL—9 General surgery
 R M ROME, W E LUNN and H W BENOIT—9 General surgery
 H L FRASER and C S COCHRANE—2 Genito urinary operations
 R A RENDICH—2 X ray demonstration

Wednesday

- W A COAKLEY—9 Plastic surgery
 L J DUNN—9 Oral surgery
 E J BROWDER—9 Neurosurgical operations
 W W HALA—9 Pathology

Thursday

- E H FISKE, J TENOPYR and J RAPHAEL—9 General surgery
 R M ROME, W E LUNN and H W BENOIT—9 General surgery
 C D NAPIER, R C WILLIAMS and J B L'EPISCOP—2 Orthopedics

Friday

- S J MCNAMARA and R H GARLICK—9 Gynecology
 H M MILLS—9 Obstetrics
 C DUNCAN and C E RYND—9 Gynecology and obstetrics
 H L FRASER and C S COCHRANE—2 Genito urinary surgery
 C F MCCARTY—2 Physiotherapy clinic

ST PETER'S HOSPITAL

Tuesday

- GORDON GIBSON—9 Gynecology
 J TODD—9 Gynecology
 H FETT—9 Orthopedics
 H MORTON—2 Genito urinary operations

Wednesday

- J E JENNINGS—9 General surgery
 T BRENNAN—9 General surgery
 F PAFFARD—9 General surgery
 W ENNIS—9 Traumatic surgery

Thursday

- J E JENNINGS—9 General surgery
 T M BRENNAN—9 General surgery
 F PAFFARD—9 General surgery
 W ENNIS—9 Traumatic surgery
 H MORTON—2 Genito urinary operations

Friday

- GORDON GIBSON—9 Gynecology
 J TODD—9 Gynecology
 H FETT—9 Orthopedics
 H MORTON—2 Genito urinary operations

ST CATHERINE'S HOSPITAL

Tuesday

- JOHN M SCANNELL and FRANK D JENNINGS—9 General surgery

Wednesday

- JOHN F GRIFFIN—9 Urology
 D GEORGE BODKIN—9 General surgery

Thursday

- CHARLES A GORDON—9 Gynecology

Friday

- MARTIN L BODKIN—9 Rectal surgery
 DANIEL A McATEER—9 General surgery

ST MARY'S HOSPITAL

Tuesday

- WILLIAM V PASCUAL—9 General surgery
 P J DULLIGAN—9 General surgery
 I A KEYES—9 Gynecology
 R B ANDERSON—9 Urology
 Staff—2 Fracture clinic

Wednesday

- J P MURPHY—9 General surgery
 T M BRENNAN—9 General surgery
 J P GLYNN—9 Gynecology
 J A SHIELDS—9 Proctology

Thursday

- WILLIAM V PASCUAL—9 General surgery
 P J DULLIGAN—9 General surgery
 I A KEYES—9 Gynecology
 R B ANDERSON—9 Urology
 Staff—2 General surgery dry clinic, transfusion

Friday

- J P MURPHY—9 General surgery
 T M BRENNAN—9 General surgery
 J P GLYNN—9 Gynecology
 T A SHIELDS—9 Proctology

METHODIST EPISCOPAL HOSPITAL

Tuesday

- R S FOWLER, T B SPENCE, C H GOODRICH and H K BELL—9 General surgery
 O P HUMPHSTONE and H B MATTHEWS—9 Obstetrics

Wednesday

- H F GRAHAM, A H BOGART and P A RENAUD—9 General surgery
 R M BEACH and H W MAYES—9 Obstetrics

Thursday

- H T LANGWORTHY—9 Urological clinic
 R S FOWLER, T B SPENCE, C H GOODRICH, R F SEIDENSTICKER and H K BELL—9 General surgery
 O P HUMPHSTONE and H B MATTHEWS—9 Obstetrics

Friday

- H F GRAHAM, A H BOGART and P A RENAUD—9 General surgery
 R M BEACH and H W MAYES—9 Obstetrics

CALEDONIAN HOSPITAL

Tuesday

- CALVIN BARBER—9 General surgical operations
 JOSEPH TENOPYR—9 General surgery, dry clinic

Wednesday

- WILLIAM A JEWETT—9 Gynecology
 JOSEPH TENOPYR—9 Gynecology
 CHARLES S COCHRANE—2 Genito urinary clinic

Thursday

- CALVIN BARBER—9 General surgery
 JOSEPH TENOPYR—9 General surgery, dry clinic

Friday

- WILLIAM A JEWETT—9 Obstetrics
 JOSEPH TENOPYR—9 Fracture clinic
 CHARLES S COCHRANE—2 Genito-urinary operations

LONG ISLAND COLLEGE HOSPITAL

Tuesday

J O POLAK WILLIAM A JEWETT GORDON GIBSON, H B MATTHEWS and A C BECK—9 Obstetrics and gynecology

J D KUSHMORF—9 Orthopedics

Wednesday

EMIL GOETSCH H F BARBER S P BARTLEY, ARTHUR GOETSCH and R I HARLOW—9 General surgery

J D KUSHMORF—9 Orthopedics

EMIL GOETSCH—2 General surgery

Thursday

J O POLAK W A JEWETT GORDON GIBSON H B MATTHEWS and A C BECK—9 Obstetrics and gynecology

J D KUSHMORF—9 Orthopedics

J S READ I I SINGER and A L HARRIS—2 Urology

Friday

EMIL GOETSCH R F BARBER S I BARTLEY ARTHUR GOETSCH and R I HARLOW—9 General surgery

J D KUSHMORF—9 Orthopedics

J S READ I L SINGER and A L HARRIS—2 Urology

BUSHWICK HOSPITAL

Tuesday

HARRY W DANGLE—9 Gynecological clinic

RICHARD C WITTHIAS—2 Genito urinary clinic

Wednesday

GEORGE H REICHERS—9 General surgery

ADOLPH V J JARDULIAN—9 General surgery

PHILIP I SMITH—2 General surgery

Thursday

NATHAN H ADLER—9 Emergency obstetrics and ward rounds

W I LIPFIELD and S S SCHLESHEIM—9 Gynecological clinic

GERARD KASLER—2 General surgery

Friday

H WRIGHT BENNETT—9 General surgery

JEWISH HOSPITAL

Tuesday

JOHN LINDER—9 General surgery

LEO S SCHWARTZ—2 Gynecological operations

Wednesday

WILLIAM LINDER—9 General surgery

ADOLPH LUNNER—2 Gynecological operations

Thursday

JOHN LINDER—9 General surgery

LEO S SCHWARTZ—2 Gynecological operations

Friday

WILLIAM LINDER—9 General surgery

ADOLPH BONNER—2 Gynecological operations

HOLY FAMILY HOSPITAL

Tuesday

JAMES M DOWNER—9 General surgical operations

Wednesday

EDWIN L FISKE—9 General surgical operations

Thursday

JOSEPH S BALDWIN—9 General surgical operations

ST JOHN'S HOSPITAL

Tuesday

WARREN L DUFFIELD—9 General surgery

STANLEY B THOMAS—9 General surgery

ROBERT B ANDERSON—10 Genito urinary operations

OSLOW A GORDON, JR—2 Obstetrics

Wednesday

HAROLD K BELL—9 General surgery

C IRANK SAMMIS—9 Plastic surgery

MCLESTI S HARRIS—9 Genito-urinary operations

ALFRED W WHITE—2 Obstetrics

Thursday

ROBERT B ANDERSON—9 Genito urinary operations

STANLEY B THOMAS—9 General surgery

CAMERON DUNCAN—2 Obstetrics

Friday

C IRANK SAMMIS—9 General surgery

WARREN L DUFFIELD—9 General surgery

HAROLD K BELL—9 General surgery

GLEN POINT HOSPITAL

Tuesday

A I SURFSI—9 General surgery

CHARLES A CORDON—2 Gynecological clinic

Wednesday

P J DELLAGAN—9 General surgery

TRUSTON WILTON—2 Gynecological clinic

Thursday

JOHN SMITH JR—9 General surgery

EMIL KOCH—2 Pathological demonstration

Friday

JOSEPH S BALDWIN—9 General surgery

CLAYSON C FICK MEMORIAL HOSPITAL

Tuesday

J F RANNEY—9 General surgical operations.

O A GORDON, JR—2 Obstetrics

Wednesday

C S COCHRANE—9 General surgical operations

H C ALLEN—2 Obstetrics

Thursday

T L VOSELMER—9 General surgical operations

Friday

H T WILLE—9 General surgical operations

NORTH COUNTRY COMMUNITY HOSPITAL

(Glen Cove)

Tuesday

A M BELL—9 Operative obstetrics

I C JESSUP—9 Medical demonstrations

Wednesday

K DERBY—9 General surgical operations

J W BULMER—9 Surgical demonstrations

Thursday

M C HILL—9 Pediatrics

G I HOCH—9 Urological operations

Friday

I D IARMORF—9 Laboratory demonstration

LUTHERAN HOSPITAL

Tuesday

A V P GARDELMAN—9 General surgery
N P RATHBUN—9 Urological clinic

Wednesday

H C FICHACKER—9 Obstetrics
HEINRICH WEHRBERG—9 Urological clinic

Thursday

VINCENT BARBER—9 General surgery
CAMFRON DUNCAN—9 Gynecology

Friday

EDWARD MAY—9 Obstetrics

KINGSTON AVENUE HOSPITAL

Wednesday

JOHN A TRIM—9 Surgical complications of contagious diseases

Thursday

RALPH F HARLOE—2 Empyemas complicating contagious diseases

JAMAICA HOSPITAL

(Richmond Hill)

Tuesday

H W BARBER—9 General surgical operations
H C COURTEN—2 Orthopedic operations

Wednesday

W H JESSUP—9 General surgical operations
F J BUYBAUM—2 Pathological conference

Thursday

L H MOSS—9 General surgical operations
A L VOLTZ—2 X ray conference

Friday

H W NEAL—9 Gynecological operations
A E BAKER—9 Obstetrical operations
H C COURTEN and A L VOLTZ—2 Fracture and X ray conference

ST JOHN'S HOSPITAL

(Long Island City)

Tuesday

D F McMAHON, I L STEIN and staff—9 General surgical operations

J J McMAHON and staff—2 Gynecological operations

Wednesday

J P McHUGH, M WEINSTEIN and staff—9 General surgical operations

H P MENCKEN and staff—2 Obstetrics

Thursday

W J LAVELLE, S M COHEN and staff—9 General surgical operations

G C BIONDI and staff—2 Urological operations

Friday

D E McMAHON, I L STEIN and staff—9 General surgical operations

MARY IMMACULATE HOSPITAL

(Jamaica)

Tuesday

FRANK M DEAN—9 General surgery

Wednesday

JOHN M SCANNELL—9 General surgery and demonstration of blood transfusion

HENRY C COURTEN—2 Orthopedic surgery

Thursday

LOUIS LICHT—9 General surgery
ROBERT B ANDERSON—9 Genito urinary surgery
FRED F KOCH—2 Surgical pathology

Friday

JOHN M SCANNELL—9 General surgery and spinal anesthesia demonstrations
ALLEN ROBINSON—2 Radium therapy

FLUSHING HOSPITAL

(Flushing)

Tuesday

G J J LAWRENCE—9 30 Gynecological operations
J W WICKHAM—9 30 General surgical operations
J L MORRISSEY—11 Gynecological operations
J S THOMAS—11 General surgical operations

Wednesday

G J J LAWRENCE—9 30 Gynecological operations
J G THOMAS—9 30 Surgical demonstrations
J S THOMAS—11 General surgical operations
J L MORRISSEY—11 Gynecological operations

Thursday

J S THOMAS, W K ROGERS and J DER COMBES—9 30 Fracture demonstration
G J J LAWRENCE and J L MORRISSEY—9 30 Gynecological operations

NASSAU HOSPITAL

(Mineola)

Tuesday

W M POST and A S WARINER—9 General surgery
W L SNEED—9 Orthopedic operations

Wednesday

B W SEAMAN and C A HETTESHEIMER—9 General surgery

O C HUDSON—9 Orthopedic operations

Thursday

H C MARTIN—9 Obstetrics and gynecology
G F CLEGHORN—9 General surgery
J W MCCLESNEY—9 Urology

Friday

G F CLEGHORN and W S S HORTON—9 General surgery

HOUSE OF ST GILES THE CRIPPLE

Tuesday

JOSEPH B L'EPISCOPO and CHARLES DWIGHT NAPIER—10 Orthopedic clinic

Thursday

JOSEPH B L'EPISCOPO and CHARLES DWIGHT NAPIER—10 Orthopedic clinic

SURGERY OF THE EYE, EAR, NOSE AND THROAT

CLINICS IN NEW YORK HOSPITALS

NEW YORK EYE AND EAR INFIRMARY

Monday

- T LAURENCE SAUNDERS—2 Ear nose and throat operations
 CLYDE S McDANNAID and TRUMAN I BOYCE—2 Eye operations

Tuesday

- W W WEEKS WENDILL I HUGHES MARY LANDIS and R E MEEK—9 Demonstration of muscular anomalies visual field changes retinal detachment
 G S DIXON and I SCHWARTZ—10 Demonstration of X ray pictures of mastoid process and nasal accessory sinuses
 B W FEE W B DOHERTY A GRIMALDI B S BEACH and H VAN LANMERS—2 Eye surgery
 J MORRISSET SMITH—2 Ear nose and throat operations

Wednesday

- BERNARD SAMUELS A R PERSE and F BRUCEHILL—9 Sympathetic ophthalmics in relation to site of wound traumatism to retina and choroid pigmentation of retina in detachment anatomy of temporal bone
 E B HURCHELL—10 Accessory sinuses relation to orbit (lantern slide demonstration) bacteriology of ear
 FRANCIS W SHINE S P OIST S A AGATSON and JESSE B STARR—2 Eye surgery
 STUART L CRAIG—2 Ear nose and throat operations

Thursday

- CONRAD BERENS and associates—9 Ophthalmological clinic
 F B HURCHELL Anatomy of the accessory sinus variations and relation to orbit and its contents Discussion by Conrad Berens
 WILLIS KNIGHTON Recent advances in cataract surgery with results
 E J BASSEN Glaucoma operations and results
 J MORRISSET SMITH—9 Mastoid operations anatomy of facial nerve (demonstration on cadaver)
 L B HURCHELL—9 Anatomy of temporal bone (lantern slide demonstration)
 JOHN MCCOY—2 Ear nose and throat operations
 W W WEEKS T H JOHNSON W I HUGHES and K I MEEK—2 Eye operations

Friday

- CLYDE F McDANNAID and TRUMAN I BOYCE—9 Eye clinic
 G S DIXON and I SCHWARTZ—10 Demonstration of X ray pictures of mastoid process and nasal accessory sinuses
 BERNARD SAMUELS CONRAD BERENS ISADORE GOLDSTEIN and WILLIS KNIGHTON—2 Eye operations
 HUGH B BLACKWELL—2 Ear nose and throat operations

KNAPP MEMORIAL EYE HOSPITAL

Tuesday

- ARNOLD KNAPP and staff—2 Eye operations

Wednesday

- ARNOLD KNAPP and staff—2 Eye operations

Thursday

- ARNOLD KNAPP and staff—2 Eye operations

MANHATTAN EYE EAR AND THROAT HOSPITAL

Monday

- H W WOOTTON and F W CRIGLER—2 Eye operations

Tuesday

- DAVID JONES—12 30 Tonsil clinic
 JOHN R LACEY and staff—2 Ear clinic
 ROSS MILLAR and staff—2 Nose and throat clinic
 I M LOW—2 Demonstration of X ray
 A J FORSTON—2 Demonstration of pathology
 H A SAEEL and G W LEEV, JR—2 Eye operations

Wednesday

- G ALLEN ROBINSON—9 Demonstration of use of radium in ear, nose and throat malignant tumors.
 DAVID JONES—12 30 Tonsil clinic
 A B DEPUIL and staff—2 Ear clinic
 HARMON SMITH and staff—2 Nose and throat clinic
 I M LOW—2 X ray demonstration
 A J FORSTON—2 Pathological demonstration
 S C KEIL and A D MINTENPORT—2 Eye operations

Thursday

- C J IMPERATORI—10 Bronchoscopic clinic
 DAVID JONES—12 30 Tonsil clinic
 I P LOWLER and staff—2 Ear clinic
 FRANCIS WHITT and staff—2 Nose and throat clinic
 F I LOWLER—2 Clinical research of ear
 V DEL J FLETCHER and J S VAN LEEFT—2 Eye operations

Friday

- G ALLEN ROBINSON—9 Demonstration of use of radium in ear nose and throat benign tumors
 DAVID JONES—12 30 Tonsil clinic
 JOHN RAE—2 Ear clinic
 J I MACKENTY—2 Nose and throat clinic
 D H WEBSTER and M COLIFF—2 Eye operations.

BETH ISRAEL HOSPITAL

Monday

- ALFRED A SCHWARTZ—2 Clinic in neuro otology

Tuesday

- JOSEPH W MILLER—9 Bronchoscopic diagnostic clinic
 IRVIN TOROK S SLOUKA and FREDERICK NEWMAN—2 Eye clinic

Wednesday

- MARIE GOTTLIEB—2 Ear surgery
 LAWRENCE D KEDWAY—2 Demonstration of colored photography of living eye

Thursday

- WILLIAM SPIELBERG—9 Rhinological surgery
 S J KOPPELZAY—2 Otological operations
 IRVIN TOROK, S SLOUKA and FREDERICK NEWMAN—2 Eye operations

Friday

- HAROLD J ISAAC—2 Nose and throat clinic

HOSPITAL FOR JOINT DISORDERS

Tuesday

- ALFRED BARNY—10 45 Ear, nose and throat operations

NEW YORK POST GRADUATE HOSPITAL

Monday

- ROBERT BUCKLEY—2 Laryngectomy or pharyngotomy for malignancy
 CLARENCE H SMITH and staff—2 Otolological operations
 E M ALGER—3 30 Eye operations and demonstration of cases
 LOUISE H MEEKER—4 Pathology of nose and throat

Tuesday

- L H MEEKER—9 Pathological lantern slide demonstration of eye cases
 C J IMPERATORI—9 Bronchoscopy
 MARVIN F JONES—10 Histological examination of the temporal bone in serial sections
 ARTHUR NILSEN—11 Ethmoid sinus operations
 G ALLEN ROBINSON—2 Demonstration of radium as a therapeutic agent
 MARVIN F JONES and staff—2 Otolological operations
 C M GRIFFITH—3 Caldwell Luc and Denker operations
 MARTIN COHEN—3 30 Eye operations and demonstration of cases

Wednesday

- JAMES W WHITE and R AEBLI—9 Eye muscle operations muscular anomalies
 VICTOR ANDERSON—9 Neck dissection and demonstration of surgical anatomy
 RAYMOND J GAFFNEY—9 Otolological operations
 ROBERT BUCKLEY—2 Laryngectomy and pharyngotomy with removal of hyoid as approach for malignancy
 GUSTAV AUFRICHT—2 Rib transplant for nasal deformity
 CLARENCE H SMITH and staff—2 Otolological operations
 DAVID ALPERIN—3 30 Eye operations and demonstration of cases

Thursday

- L H MEEKER—9 Pathological conditions of the eye (lantern slide demonstration)
 C J IMPERATORI—9 Opaque foreign bodies (lantern slide demonstration)
 DUNCAN MACPHERSON—10 Frontal sinus operations
 MARVIN F JONES—10 Histological examination of the temporal bone in serial sections
 ARTHUR NILSEN—2 Caldwell Luc operation
 C J IMPERATORI—2 Endoscopy and laryngeal operations
 MARVIN F JONES and staff—2 Otolological operations
 MARTIN COHEN—3 30 Eye operations and demonstration of cases

Friday

- J W WHITE and R AEBLI—9 Eye muscle operations, muscular anomalies
 T J HARRIS—9 Tuberculosis of larynx (lantern slides)
 R H HUTCHINSON, JR—10 Cochlear audiometric and vestibular tests
 E M ALGER—3 30 Eye operations and demonstration of cases

FORDHAM HOSPITAL

Tuesday

- JOSEPH D KELLY—9 Otolaryngological operations

Wednesday

- S H BASCH—9 Otolaryngological operations

Friday

- H G WILCOX—9 Ophthalmological operations

BELLEVUE HOSPITAL

Monday

- WILLIAM B DOHERTY and E B GRESSER—2 Eye operations
 R T ATKINS—2 Ear, nose and throat operations

Tuesday

- JOHN MILLER and E H MOYLE—10 Bronchoscopic clinic
 W C BOWERS—2 Ear nose and throat operations
 S A AGATSON and E A TUSAK—2 Eye operations

Wednesday

- WEBB W WEEKS, E B GRESSER and A E TOWN—9 Pathological eye specimens gross and microscopic
 J W FOWLES—10 Postoperative mastoid clinic
 JOHN MILLER—2 Laryngological clinic
 WEBB W WEEKS, WILLIAM B DOHERTY, S P OAST and S A AGATSON—2 Eye operations
 C J IMPERATORI—3 Bronchoscopic clinic

Thursday

- WEBB W WEEKS and S A AGATSON—9 Ophthalmoscopic cases
 E H MOYLE—10 Anatomical demonstration, ear, nose and throat specimens
 J W FOWLES and V C MCCUAIG—2 Ear, nose and throat operations
 S P OAST and E A TUSAK—2 Eye operations

Friday

- WEBB W WEEKS, E B GRESSER and A E TOWN—9 Pathological eye specimens gross and microscopic
 JOHN GUTHRIE—9 Neuro otology
 LOGAN M POPE and J SWIFT HANLEY—2 Ear, nose and throat operations
 E B GRESSER and WEBB W WEEKS—2 Eye operations

NEW YORK POLYCLINIC HOSPITAL

Monday

- WILLIAM L GATTFWOOD—2 Nose and throat operations
 ERVIN TOROK—3 Ophthalmology
 JOHN MCCOY and staff—4 Otology

Tuesday

- LEE M HURD—2 Nose and throat operations
 C E McDANALD and T A NORTHCOTT—3 Ophthalmology
 SAMUEL J KOPETZKY—4 Otology

Wednesday

- ERVIN TOROK and JOHN RICHARDSON—9 Ophthalmological operations
 WILLIAM L GATTFWOOD—2 Nose and throat clinic
 JOHN MCCOY and staff—4 Otolological operations

Thursday

- LEE M HURD—2 Nose and throat clinic
 C E McDANALD and T A NORTHCOTT—3 Ophthalmological operations
 S J KOPETZKY—4 Otolological operations

Friday

- LAWRENCE D REDWAY—9 Colored photography of living eye
 HENRY B ORTON—2 Bronchoscopy
 ERVIN TOROK—3 Ophthalmology
 JOHN MCCOY and staff—4 Otology

PRESBYTERIAN HOSPITAL

Monday

HARRY NEUFERT—2 Ear nose and throat clinic

Tuesday

THOMAS H. JOHNSON—10 Eye manifestations of brain conditions

C. G. COAKLEY—10 Follow up clinic ear, nose and throat cases

JOHN H. DUNNINGTON—2 Eye operations

LEE R. PIERCE—2 Ear nose and throat clinic

JOHN KERNAN—2 Bronchoscopy

Wednesday

DANIEL B. KIRBY—10 Eye tissue culture demonstrations

HARRY NEUFERT—10 Anatomical demonstration

GEORGE K. BRIDGEMAN—2 Ear nose and throat clinic

Thursday

JOHN M. WHEELER—10 Results of eye operations

JAMES W. BARBUCK—10 Follow up clinic ear nose and throat cases

JOHN M. WHEELER—2 Eye operations

CHARLES V. HARPER—2 Ear nose and throat clinic

Friday

JOHN H. DUNNINGTON—10 Demonstration of eye muscle conditions

PAUL NORTHINGTON—10 Studies in deafness

JOHN H. DUNNINGTON—2 Eye operations

GEORGE A. BROWN—2 Ear nose and throat clinic

ST LUKE'S HOSPITAL

Monday

WESTLEY M. HUNT—2 Nose and throat clinic

ALFRED WIENER ISAAC HARTSHORN CHARLES LITWIN
HENRY SMITH and RAYMOND I. MEIK—2 Eye clinic

Tuesday

CARL M. BUTTER—2 Ear clinic

L. T. TERRAULT and W. M. HUNT—2 Bronchoscopic clinic

ALFRED WIENER ISAAC HARTSHORN CHARLES LITWIN
HENRY SMITH and RAYMOND I. MEIK—2 Eye operations

Wednesday

A. P. VOISLAWSKY and staff—2 Nose and throat operations

ALFRED WIENER ISAAC HARTSHORN CHARLES LITWIN
HENRY SMITH and RAYMOND I. MEIK—2 Eye clinic

Thursday

WESLEY C. BOWERS and staff—2 Radical mastoid with primary skin graft

Friday

ALFRED WIENER ISAAC HARTSHORN CHARLES LITWIN
HENRY SMITH and RAYMOND I. MEIK—2 Eye clinic

LLANBON HOSPITAL

Monday

M. D. LEDERMAN and ISAAC M. HELLER—2 Otolaryngology

Friday

M. D. LEDERMAN and ISAAC M. HELLER—2 Otolaryngology

MT SINAI HOSPITAL

Monday

SIDNEY YANKAUFER MERWIN MYERSON and RUDOLPH
KRAMER—2 Bronchoscopy

J. WOLFF, K. SCHLIFER, and I. GOLDSTEIN—2 Eye clinic

Tuesday

I. FRIESNER J. MAYRAUM, WALTER HORN, S. ROSEN
JOSEPH C. DRUSS and HARRY ROSENWASSER—9
Ear operations and demonstration of cases

I. GOLDSTEIN—10 Ocular pathology

SIDNEY YANKAUFER MERWIN MYERSON and RUDOLPH
KRAMER—2 Nose and throat clinic

Wednesday

I. FRIESNER, J. MAYRAUM, WALTER HORN, S. ROSEN
JOSEPH C. DRUSS and HARRY ROSENWASSER—9
Ear operations and demonstration of cases

K. LAMBERT—10 Lunds photography

Thursday

SIDNEY YANKAUFER MERWIN MYERSON and RUDOLPH
KRAMER—2 Bronchoscopy

I. GOLDSTEIN—10 Ocular pathology

J. WOLFF, K. SCHLIFER, and I. GOLDSTEIN—2 Eye clinic

Friday

SIDNEY YANKAUFER MERWIN MYERSON and RUDOLPH
KRAMER—2 Nose and throat clinicH. MINSKY—10 Improved methods of focal illumination
and transillumination

CITY HOSPITAL

Monday

A. N. SCHILLER—2 Ear nose and throat clinic

Thursday

O. C. KISCH—2 Ear, nose and throat clinic

ST MARY'S HOSPITAL

Wednesday

JAMES W. BARCOCK—9 Ear nose and throat conditions
in children

FLOWER HOSPITAL

Thursday

J. A. W. HETRICK—2 Mastoid problems
EDWIN S. MUNN—2 Muscular imbalance of the eye
WILLIAM McFARLAN—2 Cataracts (Barraguer technique)
ARTHUR CHAMBERS—2 Ophthalmological clinic

LINCOLN HOSPITAL

Tuesday

J. S. HANLEY—2 Otolaryngological operations

Thursday

H. K. FUGGETT and M. BERGER—2 Otolaryngological
operations

MOKKISANIA HOSPITAL

Tuesday

CLARENCE H. SMITH and staff—2 Otolaryngological
operations

Thursday

DAVID H. JONES—2 Bronchoscopic clinic

FIFTH AVENUE HOSPITAL

Thursday

WESTLEY M. HUNT—2 Otolaryngological operations and demonstration of cases

Friday

LEGRAND H. HARDY and L. H. ELLIS—2 Ophthalmological operations and demonstration of cases

MIDTOWN HOSPITAL

Monday

RAYMOND I. OSEY—2 Ophthalmological surgery

Tuesday

BENJAMIN FREUDENTHAL—9 30 Nose and throat surgery

ST. VINCENT'S HOSPITAL

Monday

JOHN D. KERNAN—2 Bronchoscopic clinic

Tuesday

JOHN M. LORE—2 Bronchoscopic clinic

GOUVERNEUR HOSPITAL

Friday

WILLIAM L. GATEWOOD—2 Nose and throat clinic

LINCOLN HILL HOSPITAL

*Thursday*JOHN KERNAN and G. F. OBPRENDER—9 Bronchoscopic clinic
RUDOLF C. DENIG, JOHN J. REID and F. VINCENT GUINÉE—2 Eye operations

CORRECTION HOSPITAL

Monday

JAMES W. SMITH—2 Ophthalmic surgery

Friday

JOSEPH ROSENBERG—9 Ear, nose and throat clinic

METROPOLITAN HOSPITAL

Thursday

J. A. W. HETRICK and staff—10 Surgery of the nose and throat

HARLEM HOSPITAL

Wednesday

L. HUBBY—2 Otolaryngology

MISERICORDIA HOSPITAL

Tuesday

ROBERT E. BUCKLEY—2 Ear, nose and throat operations

CLINICS IN BROOKLYN AND LONG ISLAND HOSPITALS

BROOKLYN EYE AND EAR HOSPITAL

*Tuesday*C. G. CRANE, F. H. LASHER and F. J. McCAMMON—2 Ear, nose and throat clinic
J. OHLY, D. BISHOP, and F. C. PLACE—2 Eye clinic*Wednesday*Staff—9 Special clinical demonstrations in ophthalmology and otolaryngology
H. H. WAUGH, JAMES ANDREW and L. M. BEERY—2 Eye clinic
F. L. TUCKER, W. HERBERT and I. G. CAMERON—2 Ear, nose and throat clinic*Thursday*C. G. CRANE, F. H. LASHER and F. J. McCAMMON—2 Ear, nose and throat clinic
J. OHLY, D. BISHOP and F. C. PLACE—2 Eye clinic*Friday*H. H. WAUGH, JAMES ANDREW and I. M. BEERY—2 Eye clinic
F. L. TUCKER, W. HERBERT and I. G. CAMERON—2 Ear, nose and throat clinic

BROOKLYN HOSPITAL

Wednesday

C. G. CRANE—2 Ear, nose and throat operations and bronchoscopic clinic

Friday

C. G. CRANE—2 Ear, nose and throat operations and bronchoscopic clinic

WYCKOFF HEIGHTS HOSPITAL

*Tuesday*ROBERT L. MOORHEAD—2 Nose and throat clinic
CARL MUELLER, Sr.—3 Ophthalmological operations*Wednesday*CARL H. MUELLER, Jr.—2 Nose and throat clinic
IRVING CAMERON—3 Nose and throat clinic*Thursday*ROBERT L. MOORHEAD—2 Nose and throat clinic
CARL MUELLER, Sr.—3 Ophthalmological operations*Friday*CARL H. MUELLER, Jr.—2 Nose and throat clinic
IRVING CAMERON—3 Nose and throat clinic

ST. CATHERINE'S HOSPITAL

Tuesday

S. H. DE COSTE—2 Ear, nose and throat clinic

Wednesday

JOSEPH E. GOLDING—2 Ophthalmology

Thursday

G. GARTHWAITHE FISHER—2 Ear, nose and throat clinic

CALEDONIAN HOSPITAL

Tuesday

JOHN W. DURKEE—2 Otolaryngology

Thursday

JOHN W. DURKEE—2 Otolaryngological operations

LUTHERAN HOSPITAL

Tuesday

A GILLICAN—9 Otolaryngology

Wednesday

PETER HEIL—9 Otolaryngology

Thursday

A GILLICAN—9 Otolaryngology

JOHN W. GREEN—2 Ophthalmological clinic

Friday

PETER HEIL—9 Otolaryngology

CUNIBLIAND HOSPITAL

Tuesday

JOHN H. BAILEY and staff—2 Eye clinic operations and demonstration of cases

Wednesday

F. H. LASHER and staff—2 Nose and throat clinic, operations, bronchoscopy demonstration of cases

KINGS COUNTY HOSPITAL

Tuesday

J. W. DIERKE and M. G. GOLDEN—9 Otolaryngology

Wednesday

J. OHLY and W. MOEHLE—2 Eye surgery

J. W. DIERKE and M. C. MYERSON—2 Otolaryngology

C. A. HARTIG—2 Eye clinic

METHODIST EPISCOPAL HOSPITAL

Wednesday

C. I. STONE, C. A. ANDERSON, F. A. SUNDE and H. GLEDHILL—2 Otolaryngology

Friday

C. I. STONE, C. A. ANDERSON, F. A. SUNDE and H. GLEDHILL—2 Otolaryngology

ST. MARY'S HOSPITAL

Tuesday

G. F. DELLY—2 Nose and throat clinic

Thursday

G. F. DELLY—2 Nose and throat clinic

JAMAICA HOSPITAL

(Kitchener Hill)

Wednesday

J. KANE—2 Eye, ear, nose and throat clinic

Thursday

A. J. SHEPHERD—2 Eye, ear, nose and throat clinic

MARY IMMACULATE HOSPITAL

(Jamaica)

Tuesday

DANIEL S. CUNNING—9 Nose and throat clinic

Wednesday

EDWARD GROTHINGHAM—9 Nose and throat clinic

ST. JOHN'S HOSPITAL

Tuesday

JOHN P. BAKER—2 Otolaryngology

Wednesday

ROBERT I. MOORHEAD—2 Otolaryngology

Thursday

JOHN P. BAKER—2 Otolaryngology

Friday

ROBERT I. MOORHEAD—2 Otolaryngology

J. I. WISH HOSPITAL

Tuesday

EDWARD I. BERGER—2 Nose and throat operations.

Wednesday

I. HILF LEIBOWITZ—2 Nose and throat clinic

Thursday

EDWARD I. BERGER—2 Nose and throat operations.

Friday

I. HILF LEIBOWITZ—2 Nose and throat operations.

ST. PETER'S HOSPITAL

Tuesday

A. KEFMAN—2 Nose and throat clinic

Wednesday

M. G. GOLDEN—2 Bronchoscopy

Thursday

M. C. GOLDEN—2 Nose and throat clinic

LONG ISLAND COLLEGE HOSPITAL

Tuesday

C. W. STICKLER—2 Laryngology

H. M. SMITH—2 Ophthalmology

GREENPOINT HOSPITAL

Wednesday

JOSEPH I. BRAUNSTEIN and staff—2 Nose and throat clinic

NASSAU HOSPITAL

(Mineola)

Friday

H. B. SMITH—9 Nose and throat clinic

NORTH COUNTRY COMMUNITY HOSPITAL

(Glen Cove)

Friday

G. H. COX—9 Nose and throat operations

ST. JOHN'S HOSPITAL

(Long Island City)

Friday

P. J. KENNEDY and staff—2 Bronchoscopy

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